



# BCAM ACTIVITY REPORT 2020

(bcam)  
basque center for applied mathematics

(bcam)

basque center for applied mathematics

(matematika mugaz bestekide)

x)





(bcam)

center for advanced mathematics



EXCELENCIA  
SEVERO  
OCHOA

# INDEX

The background features a complex, layered geometric pattern. It consists of numerous overlapping, semi-transparent shapes in various shades of blue, ranging from light sky blue to deep navy blue. These shapes are primarily triangles and polygons, some pointing upwards and others downwards, creating a sense of depth and movement. A large, light grey square is positioned in the upper left quadrant, partially overlapping the blue shapes. The overall effect is a modern, abstract, and textured design.

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# INTRODUCTION

**1.**

## THE BEAUTY OF MATHEMATICS ONLY SHOWS ITSELF TO MORE PATIENT FOLLOWERS

*Maryam Mirzakhani*



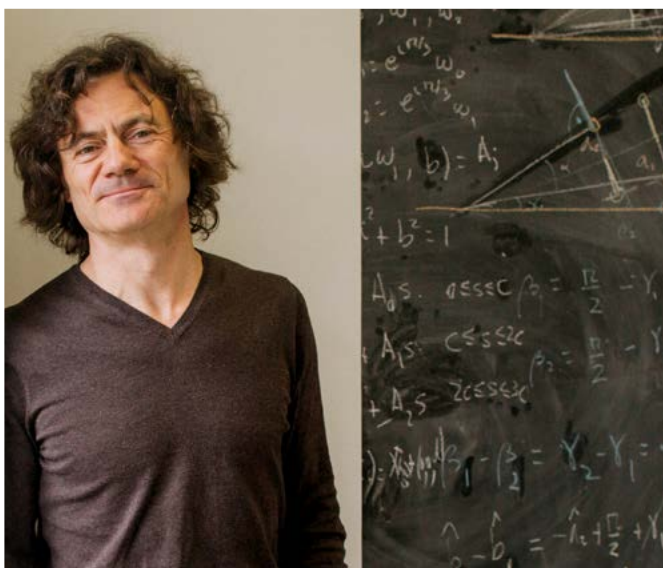
## THE ONLY UNIVERSAL LANGUAGE

BCAM is a world-class interdisciplinary Research Center in the field of Applied Mathematics that was founded in 2008 as a Basque Excellence Research Center (BERC), with a focus on interdisciplinary research in Mathematics, as well as training and attracting talented scientists, and promoting scientific and technological advances worldwide. The center has been awarded (2013, 2018) twice with the Severo Ochoa distinction that consolidates BCAM as one of the most relevant institutions of the field in Europe.

From the inception of humanity, Mathematics has always been the basis on which all natural and social sciences have been supported. Reciprocally, sciences have been the source of inspiration for most mathematical developments throughout history. In recent decades, technology has joined science in promoting Mathematics, demanding new mathematical developments capable

of modelling such technology and predicting its behaviour. Similar to the case of science, this modern Mathematics is resulting in new technological advances. In BCAM, our goal is to be leaders in the discovery of the necessary Mathematics that contribute to a scientific and technological development oriented towards social welfare. That is, our goal is to write together the Mathematics of the future.

With the mission “mathematics in the service of society”, we are committed to establishing links and collaborations with industry, R&D companies and social institutions, in order to transfer our excellence research in Applied Mathematics to diverse areas (industrial, energy, materials, health, social, ecological, financial...), contributing in a sustainable manner to XXI century societal challenges.



Definitively 2020 will be remembered as a year that changed our lives. The break out of COVID-19 flooded our entire world and particularly BCAM was also affected. In spite of the lock down we tried to keep people engaged and positive by developing numerous catching activities and we think we succeeded in most of the occasions. While COVID has supposed a big issue, it has also ended up being a source of opportunities for showing the relevance of the contribution of science to society. In this sense BCAM researchers have joined all their efforts in providing analytical tools and accurate predictions to the Basque Government in order to allow them to provide resources in advance and take informed decisions.

Despite having to confront all these special circumstances the research health of the center has been kept at its maximum. We have reached more than 150 journal publications and increase our h-index to 40. Most of these publications are in Q1 (86,1%) and/or D1 (48,3%) meaning that they own a high quality. These publications are mainly in the wide field of applied mathematics, however our interdisciplinary nature made possible to produce contributions in other research fields such as material science, biology, health, etc. In addition this year we have incorporated a record number of 25 researchers.

While the pandemic prohibited from having personal contact we continued the relation with our collaborators virtually. As a consequence we got for the first time a Future and Emerging Technologies (FET) project, contributed to the Mathematics Laboratory for Trans-border Cooperation – Transmath,

**ikerbasque**  
Basque Foundation for Science

**innobasque**  
berrikuntza agentzia  
euskal agentzia  
de la innovación

  
 Universidad  
del País Vasco  
Euskal Herriko  
Unibertsitatea

  
**Petronor**  
Innovación

  
**Bizkaia**  
foru aldundia  
diputación foral

1.




led the Spanish Network of Mathematics and signed six agreements with international institutions for the co-supervision of Postdoctoral Fellows and PhD Students and exchange of senior researchers. Last but not least, we would like to emphasize the activities of the Knowledge Transfer Unit, where we have signed several contracts with companies in order to provide mathematical solutions to their real problems and setting up agreements to co-supervised industrial PhD thesis.

All these contributions would have not been possible without the strong contribution of public and private institutions, which have continued trusting on us in these difficult scenarios.

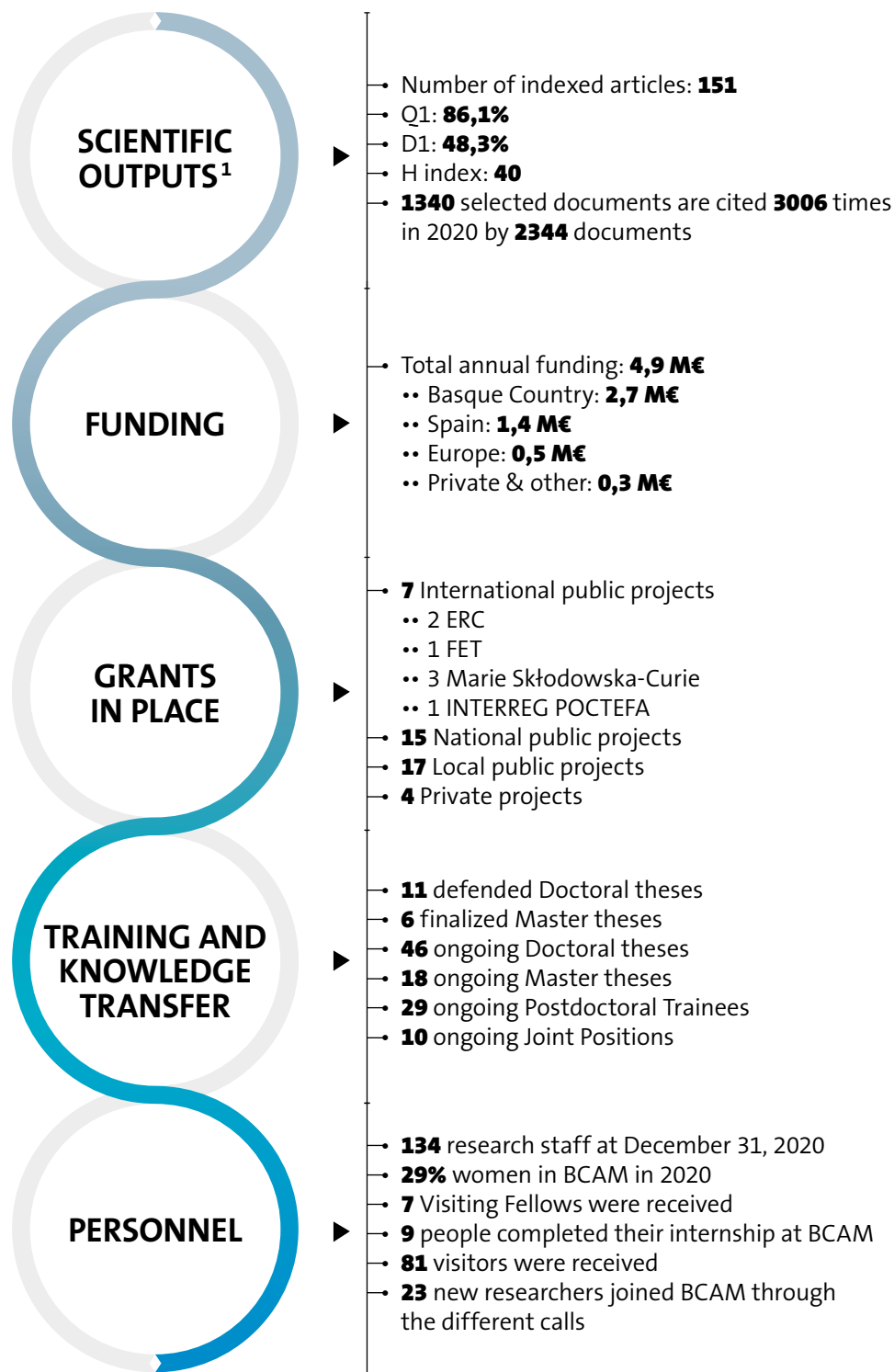
Lastly, we would like to highlight the leitmotiv of the center: "Lets write together the mathematics of the future".

***José Antonio Lozano***  
*Scientific Director*










BCAM  
IN NUMBERS

2.

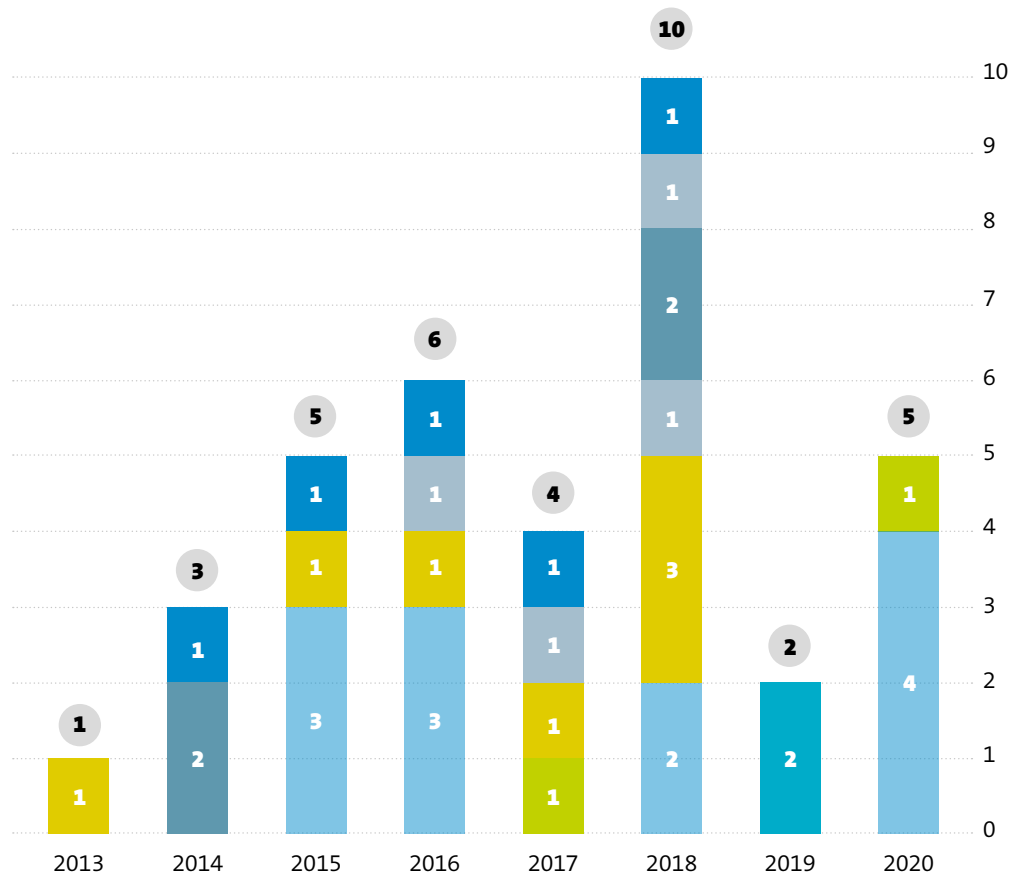


<sup>1</sup> Year range: 2020. Data source: scopus. Date exported: 15/01/20 citations updated: 08/07/20. First Quartile (Q1) Top 25% journals by Scimago ranking on 2020 (SJR2020). First Decile (D1) Top 10% journals by Scimago ranking on 2020 (SJR2020). The h-index: Hirsch JE. An index to quantify an individual's scientific research output. Proc Natl Acad Sci U S A. 2005 November 15; 102(46): 16569–16572. doi: 10.1073/pnas.0507655102

## COMPETITIVE INDIVIDUAL GRANTS

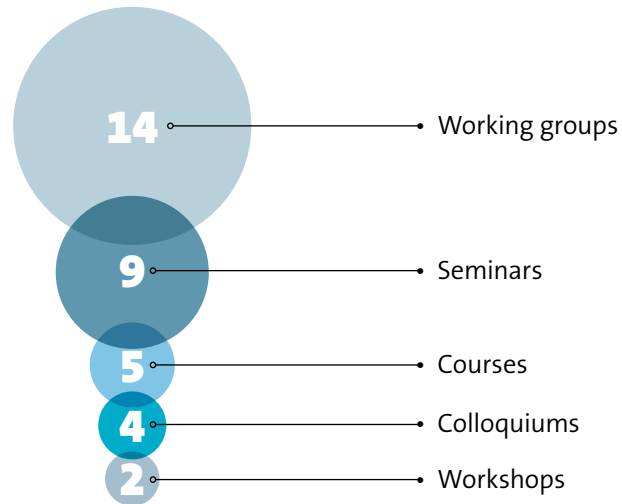
-  Ikerbasque Professor
-  Ikerbasque Associate
-  Marie Curie
-  Ramón y Cajal
-  Ikerbasque Fellow
-  Junior Leader "La Caixa"
-  Juan de la Cierva

**ikerbasque**  
Basque Foundation for Science



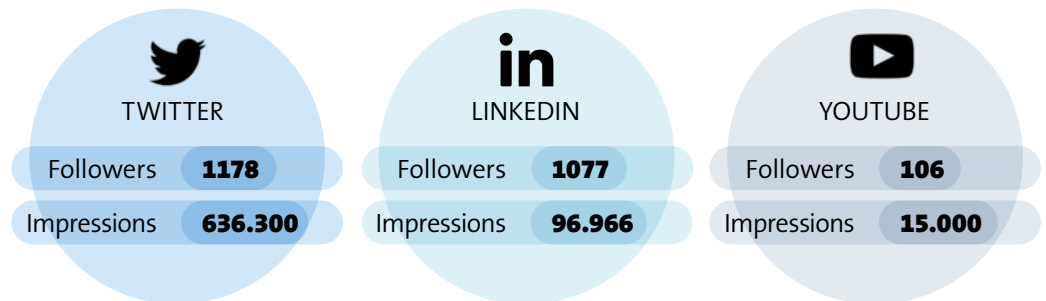
- 23 researchers have been incorporated during 2020 in the different BCAM calls
- BCAM has received 81 visitors, 7 visiting fellows and 39 internships
- 4 BCAM researchers have been awarded a Juan de la Cierva Grant
- 1 BCAM researcher has been awarded a Junior Leader "La Caixa" Grant

## SCIENTIFIC ACTIVITIES IN 2020



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## SOCIAL MEDIA



Data source: Twitter, LinkedIn and Youtube. Data exported: 31/12/2020.

## 4 new International projects

### AEROSIMULAT ●

High-performance aerodynamics and aeroacoustics simulations of the new generation of high-speed gas turbines via high-order Galerkin methods.

- **Coordinator:**  
BCAM - Basque Center for Applied Mathematics
- **Partners:**  
New Jersey Institute of Technology

### ADAM^2 ●

Analysis, Design, and Manufacturing using Microstructures.

- **Coordinator:**  
BCAM - Basque Center for Applied Mathematics
- **Participants:**
  - Technion  
Israel Institute of Technology
  - Ecole Polytechnique  
Federale de Lausanne
  - Universidad del País Vasco / Euskal Herriko Unibertsitatea
  - Institut National de Recherche en Informatique et Automatique
  - Technische Universitaet Wien
  - Trimek S.A.
  - Stratasys LTD
  - Hutchinson S.A.
  - Seoul National University

### ASTROTECH ●

Disruptive materials, technologies & approaches to unravel the role of Astrocytes in brain function and dysfunction: towards to Glial interfaces.

- **Coordinator:**  
Consiglio Nazionale Delle Ricerche
- **Participants:**
  - The Chancellor Masters and Scholars of The University of Cambridge
  - USTAV Experimentalni Mediciny Akademie Ved Ceske Republiky Verejna Vyzkumna Institute
  - Universite D'Aix Marseille
  - BCAM - Basque Center for Applied Mathematics
  - INEB-Instituto Nacional De Engenharia Biomedica
  - Universita Degli Studi Di Bari Aldo Moro
  - Fondazione Istituto Italiano Di Tecnologia
  - Agencia Estatal Consejo Superior De Investigaciones Cientificas
  - Avanzare Innovacion

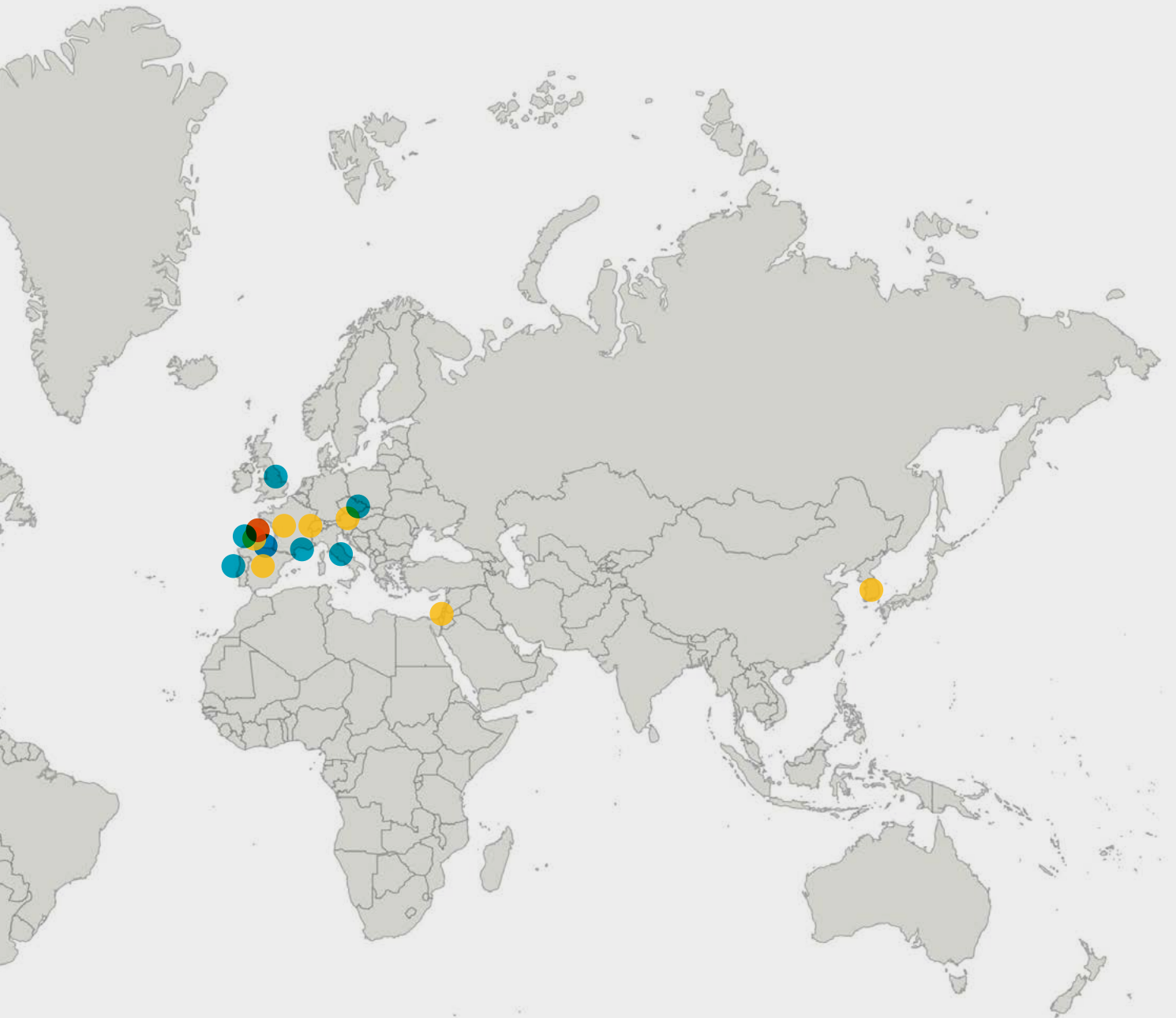
### AXA RESEARCH FUND ●

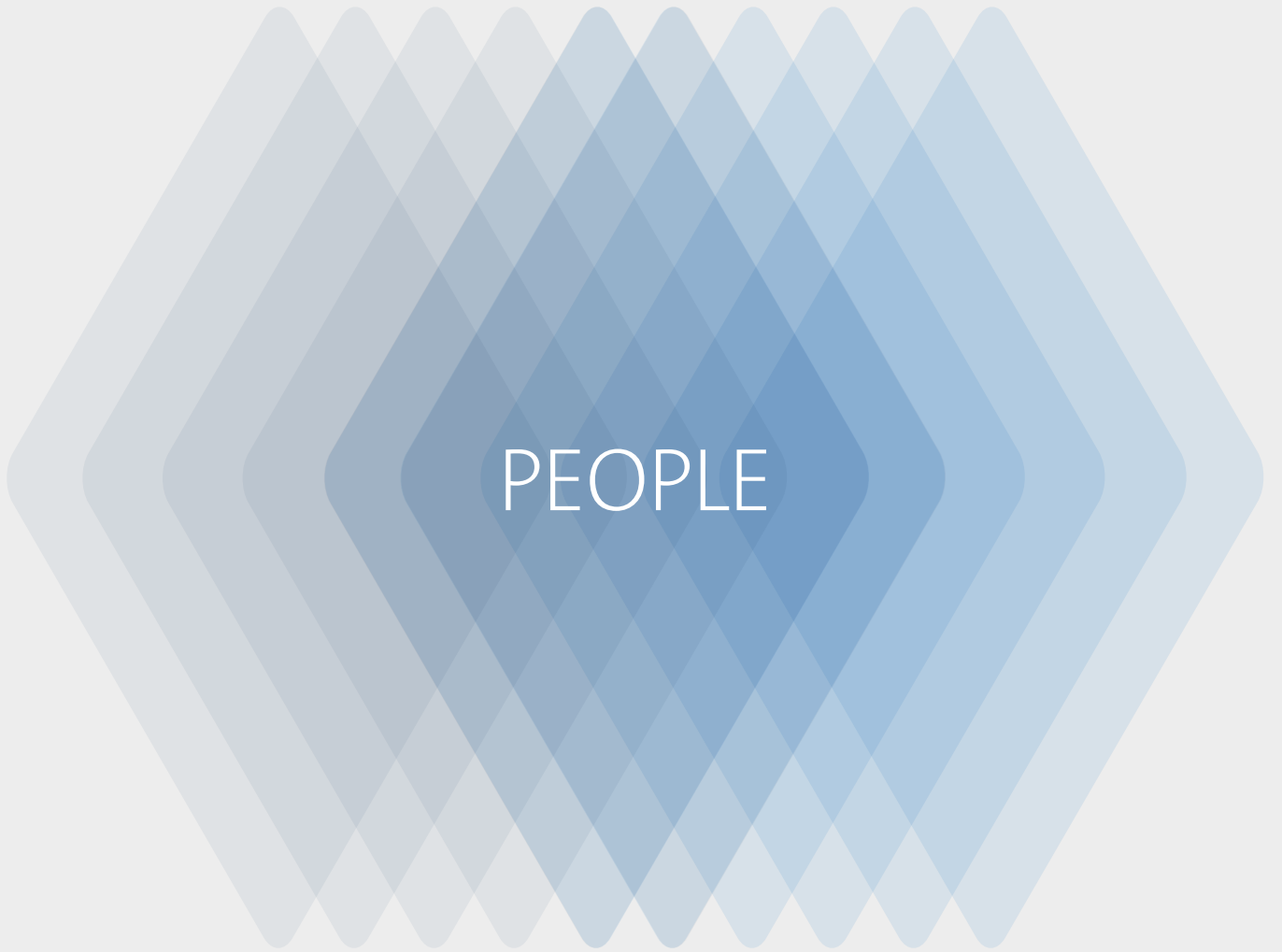
Early Prognosis of COVID-19 Infections via Machine Learning.

- **Coordinator:**  
BCAM- Basque Center for Applied Mathematics



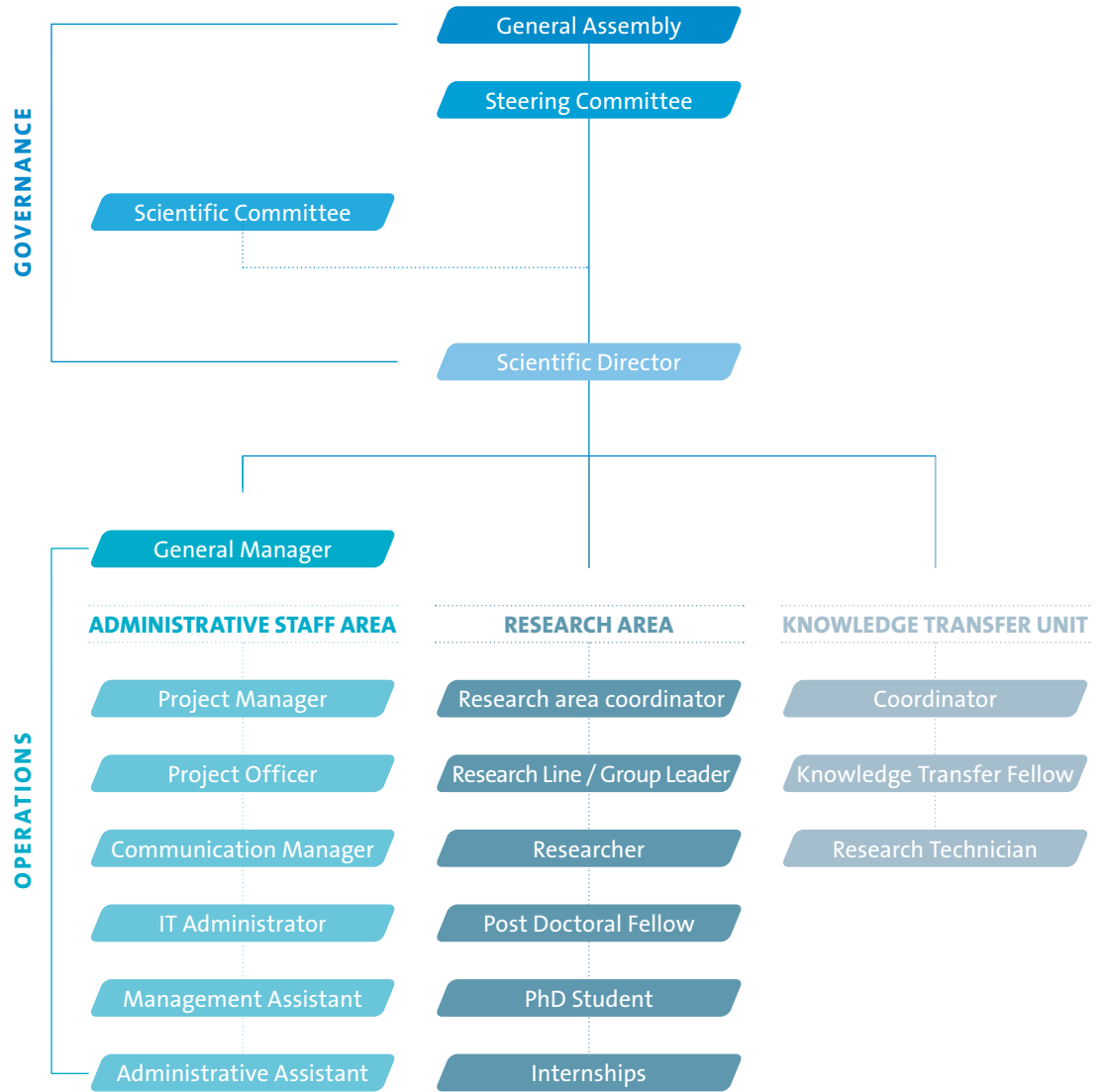
# INTERNATIONALIZATION



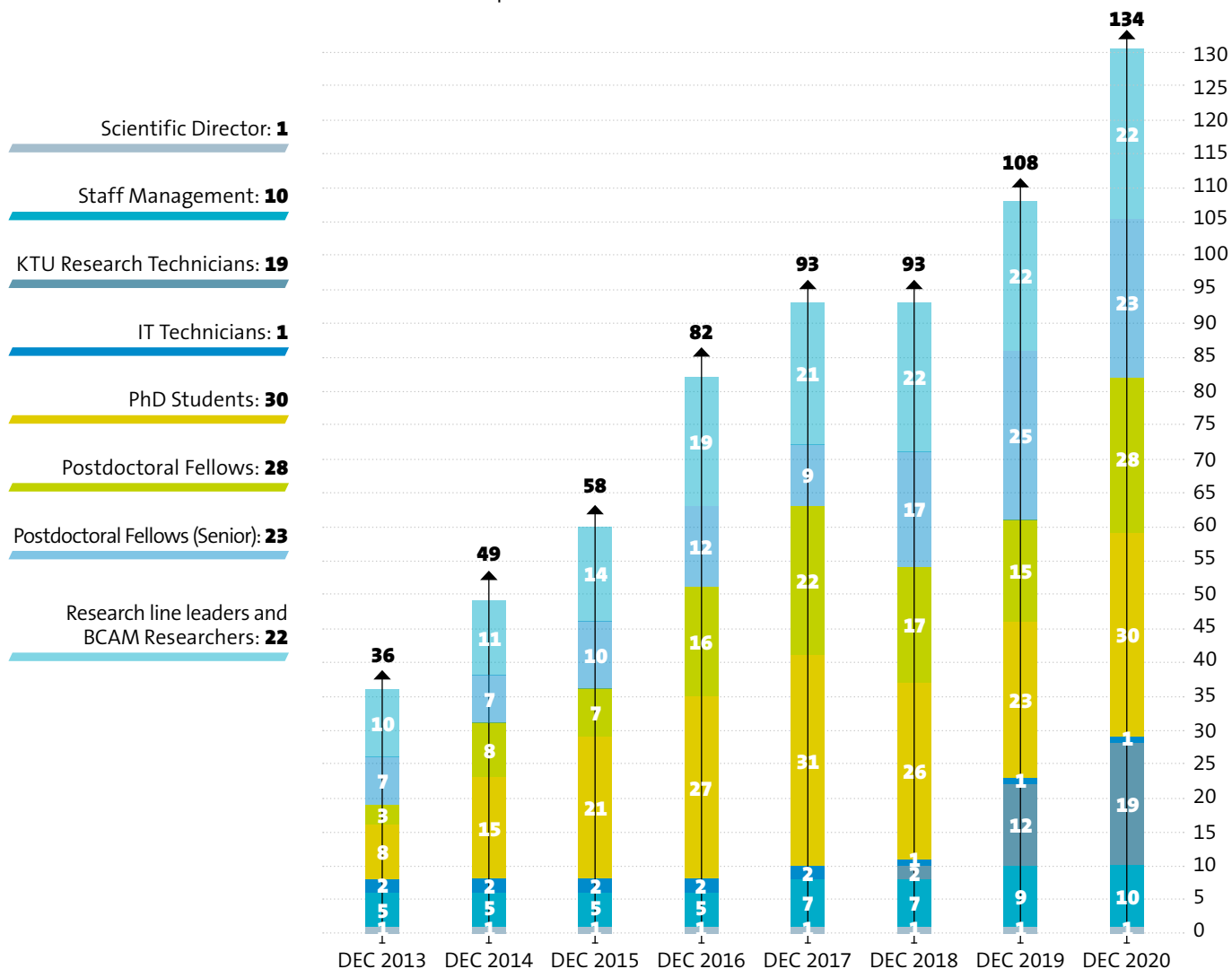


3.





Below is the evolution of personnel at the center in the period 2013-2020:



Moreover, during 2020:

- 23 new researchers have joined BCAM through the different calls
- 7 Visiting Fellows were received
- 39 people completed their internship at BCAM
- 81 Visitors were received
- 11 doctoral theses have been defended with BCAM affiliation and whose thesis supervisors are affiliated to the center

$$Y := L^2([-z, 0], \mathbb{R}) \quad L_{11}, L_{21}: Y \rightarrow \mathbb{R}$$

$$Z := L^2([-z, 0], \mathbb{R}) \quad L_{12}, L_{22}: Z \rightarrow \mathbb{R}$$

group with IG  $\mathcal{A}$

$$\text{and } \left. \begin{aligned} \phi(0) &= L_{11}\phi + L_{12}\psi \\ \phi'(0) &= L_{21}\phi + L_{22}\psi \end{aligned} \right\}$$

$$\Leftrightarrow (y_t, z_t) = (u(t), v(t))$$

Discrete problem:

$$M \in \mathbb{N} \text{ with } M > 0$$

$$\Omega_M = \{\theta_0, \theta_1, \dots, \theta_M\}$$

$$0 = \theta_0 < \theta_1 < \dots < \theta_{M-1} < \theta_M =$$

$$Y_M := \mathbb{R}^{\Omega_M \setminus \{0\}} \cong \mathbb{R}^M$$

$$Z_M := \mathbb{R}^{\Omega_M} \cong \mathbb{R}^{M+1}$$

$$\Phi := (\Phi_1, \dots, \Phi_M) \in Y_M$$

$$\Psi := (\Psi_0, \Psi_1, \dots, \Psi_M) \in Z_M$$

$$\mathcal{N}_M \cong \mathcal{N}$$

$\Rightarrow$  The eigenvalues

$$\lambda \in \sigma(\mathcal{N})$$

$$\lambda_m \in \sigma(A_M)$$

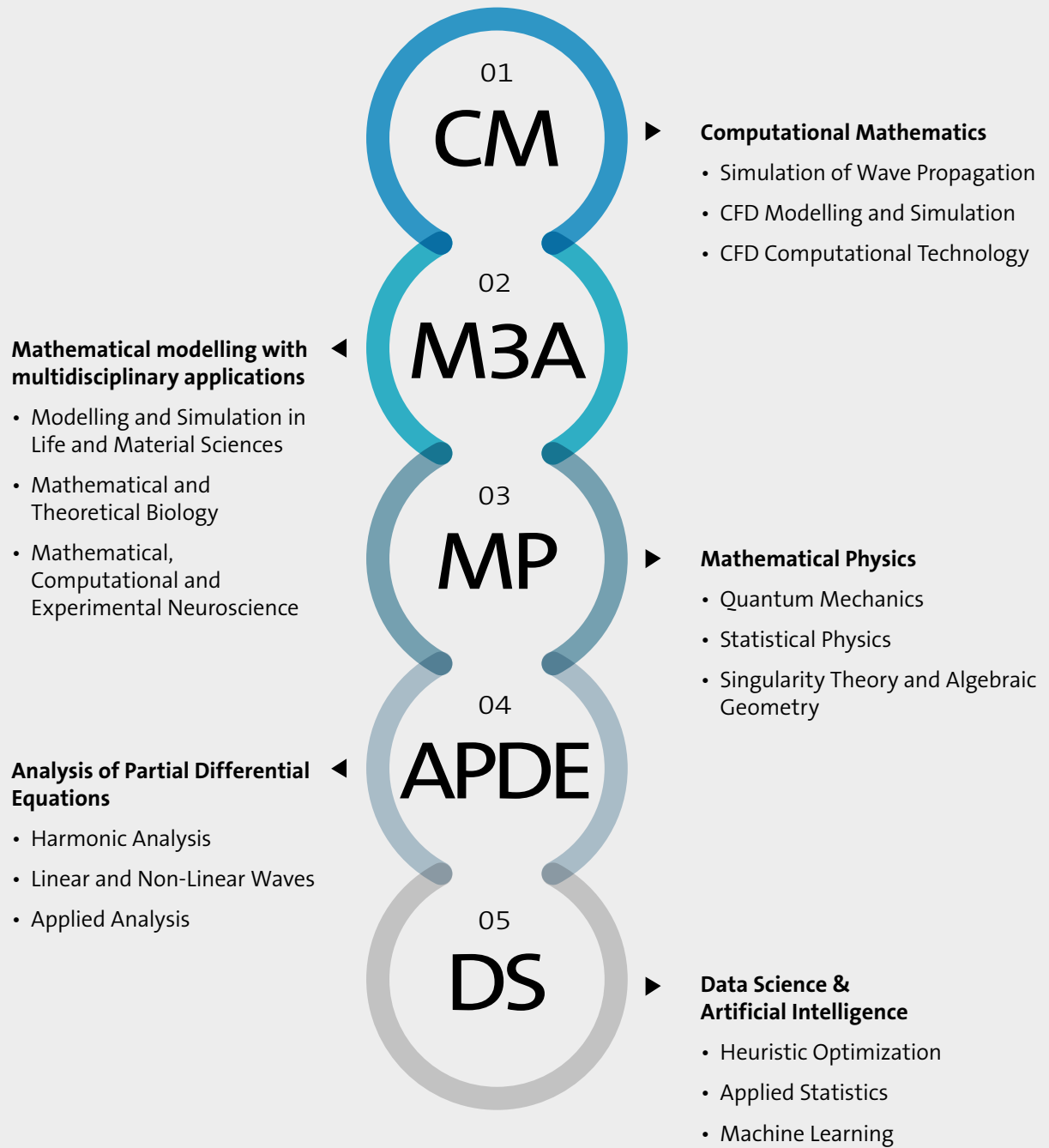
$$\lambda_m \rightarrow \lambda$$

# 3.1.

## RESEARCH AREAS AND LINES

In 2020, under the Scientific Direction of Prof. Jose Antonio Lozano, BCAM research lines have progressed in their consolidation, adapting them to the natural evolution of the centre.

The research tasks that have been developed at BCAM have been carried out through the established groups and research lines, organised thematically into 5 common areas from the scientific point of view.



### 3.1.1. BCAM RESEARCH STAFF IN 2020



**SCIENTIFIC  
DIRECTOR**

*José Antonio  
Lozano Alonso*

*UPV/EHU Professor  
& BCAM*

RESEARCH  
AREA

**DS**

RESEARCH  
LINES

**ML**

#### PROFESSORS

<b>Akhmatskaya, Elena</b>	<i>Ikerbasque Professor at BCAM</i>	<b>M3A</b>	<b>MSLMS</b>
<b>Bru, Jean-Bernard</b>	<i>Ikerbasque Professor at BCAM &amp; UPV/EHU</i>	<b>MP</b>	<b>QM</b>
<b>Ellero, Marco</b>	<i>Ikerbasque Professor at BCAM</i>	<b>CM</b>	<b>CFDMS</b>
<b>Fernandez de Bobadilla, Javier</b>	<i>Ikerbasque Professor at BCAM</i>	<b>MP</b>	<b>STAG</b>
<b>Pardo, David</b>	<i>Ikerbasque Professor at BCAM &amp; UPV/EHU</i>	<b>CM</b>	<b>SIWP</b>
<b>Pérez, Carlos</b>	<i>Ikerbasque Professor at BCAM &amp; UPV/EHU</i>	<b>APDE</b>	<b>HA</b>
<b>Rodrigues, Serafim</b>	<i>Ikerbasque Professor at BCAM</i>	<b>M3A</b>	<b>MCEN</b>



		RESEARCH AREA	RESEARCH LINES
<b>Vega, Luis</b>	<i>UPV/EHU Professor &amp; BCAM</i>	<b>APDE</b>	<b>WAVE</b>
<b>Zarnescu, Arghir Dani</b>	<i>Ikerbasque Professor at BCAM UPV/EHU</i>	<b>APDE</b>	<b>AA</b>
<b>Arostegui, Inmaculada</b>	<i>UPV/EHU Professor linked to BCAM</i>	<b>DS</b>	<b>AS</b>
<b>Murua, Ander</b>	<i>UPV/EHU Professor linked to BCAM</i>	<b>CM</b>	<b>SIWP</b>
<b>Pérez Sainz de Rozas, Gloria Isabel</b>	<i>UPV/EHU Professor linked to BCAM</i>	<b>DS</b>	<b>HO</b>

### 3.1.1. RESEARCHERS

#### ASSOCIATE & FELLOW RESEARCHERS

		RESEARCH AREA	RESEARCH LINES
<i>Aguiar, Maíra</i>	<i>Ikerbasque Research Fellow &amp; Research Line Leader</i>	<b>M3A</b>	<b>MTB</b>
<i>Bartoñ, Michael</i>	<i>Ikerbasque Research Associate &amp; Ramon y Cajal Fellow</i>	<b>CM</b>	<b>SIWP</b>
<i>Lee, Dae-Jin</i>	<i>BCAM Researcher &amp; Research Line Leader</i>	<b>DS</b>	<b>AS</b>
<i>Lucà, Renato</i>	<i>Ikerbasque Research Fellow</i>	<b>APDE</b>	<b>WAVE</b>
<i>Mazuelas, Santiago</i>	<i>Ikerbasque Research &amp; Ramon y Cajal Fellow</i>	<b>DS</b>	<b>ML</b>
<i>Nava, Vincenzo</i>	<i>BCAM Researcher</i>	<b>CM</b>	<b>CFDMS</b>
<i>Pagnini, Gianni</i>	<i>Ikerbasque Research Associate &amp; Research Line Leader</i>	<b>MP</b>	<b>SP</b>
<i>Perez, Pedro</i>	<i>Ikerbasque Research Associate</i>	<b>APDE</b>	<b>HA</b>
<i>Rodríguez, Maria Xose</i>	<i>Ikerbasque Research Fellow</i>	<b>DS</b>	<b>AS</b>
<i>Roncal, Luz</i>	<i>Ikerbasque Research &amp; Ramon y Cajal Fellow</i>	<b>APDE</b>	<b>HA</b>



**POSTDOCTORAL FELLOWS**

	RESEARCH AREA	RESEARCH LINES
<i>Abedi, Mohammad Mahdi</i>	<b>CM</b>	<b>SIWP</b>
<i>Álvarez, Julen</i>	<b>CM</b>	<b>SIWP</b>
<i>Armañanzas, Ruben</i>	<b>DS</b>	<b>ML</b>
<i>Balboa, Florencio</i>	<b>CM</b>	<b>CFDMS</b>
<i>Bravin, Marco</i>	<b>APDE</b>	<b>WAVE</b>
<i>Costa de Sousa, Mateus</i>	<b>APDE</b>	<b>HA</b>
<i>Cusimano, Nicole</i>	<b>M3A</b>	<b>MTB</b>
<i>Das, Moumita</i>	<b>DS</b>	<b>AS</b>
<i>De Pitta, Maurizio</i>	<b>M3A</b>	<b>MCEN</b>
<i>García, Fernando</i>	<b>DS</b>	<b>AS</b>
<i>Geng, Zhiyuan</i>	<b>APDE</b>	<b>AA</b>
<i>Gordaliza, Paula</i>	<b>DS</b>	<b>AS</b>
<i>Hashemian, Ali</i>	<b>CM</b>	<b>SIWP</b>
<i>Hazra, Arijit</i>	<b>CM</b>	<b>SIWP</b>
<i>Iakunin, Sergei</i>	<b>APDE</b>	<b>WAVE</b>
<i>Inouzhe, Hristo</i>	<b>DS</b>	<b>AS</b>
<i>Knopoff, Damian Alejandro</i>	<b>M3A</b>	<b>MTB</b>
<i>Kumar, Sandeep</i>	<b>APDE</b>	<b>WAVE</b>
<i>León, Carlos Alberto</i>	<b>M3A</b>	<b>MSLMS</b>
<i>Martínez, Joaquín</i>	<b>DS</b>	<b>AS</b>
<i>Mo, Chaojie</i>	<b>CM</b>	<b>CFDMS</b>
<i>Moragues, Margarida</i>	<b>CM</b>	<b>CFDCT</b>
<i>Moreno, Nicolas</i>	<b>CM</b>	<b>CFDMS</b>
<i>Muñoz, Judit</i>	<b>CM</b>	<b>SIWP</b>
<i>Nguyen, Xuan Viet Nhan</i>	<b>MP</b>	<b>STAG</b>

### 3.1.1. RESEARCHERS

#### POSTDOCTORAL FELLOWS

	RESEARCH AREA	RESEARCH LINES
<i>Nieraeth, Zoe</i>	<b>APDE</b>	<b>HA</b>
<i>Nieto, David</i>	<b>CM</b>	<b>CFDMS</b>
<i>Pelka, Tomasz Ryszard</i>	<b>MP</b>	<b>STAG</b>
<i>Pérez, Aritz</i>	<b>CM</b>	<b>ML</b>
<i>Pohjola, Carl Valter</i>	<b>APDE</b>	<b>HA</b>
<i>Ponce, Felipe Eduardo</i>	<b>APDE</b>	<b>HA</b>
<i>Puchhammer, Florian</i>	<b>M3A</b>	<b>MSLMS</b>
<i>Rincón, Mauricio</i>	<b>M3A</b>	<b>MSLMS</b>
<i>Rochera, David</i>	<b>CM</b>	<b>SIWP</b>
<i>Rojas-Delgado, Jairo</i>	<b>DS</b>	<b>ML</b>
<i>Rossi, Emanuele</i>	<b>CM</b>	<b>CFDMS</b>
<i>Ruiz-Lopez, Jose Antonio</i>	<b>CM</b>	<b>CFDMS</b>
<i>Rusconi, Simone</i>	<b>CM</b>	<b>MSLMS</b>
<i>Savarimuthu, Sagaya Prasanna Kumar</i>	<b>CM</b>	<b>CFDMS</b>
<i>Schenk, Christina</i>	<b>M3A</b>	<b>MSLMS</b>
<i>Sliusarenko, Oleksii</i>	<b>CM</b>	<b>SIWP</b>
<i>Smyrnelis, Panayotis Alexandros</i>	<b>APDE</b>	<b>AA</b>
<i>Szarek, Tomasz Zachary</i>	<b>APDE</b>	<b>HA</b>
<i>Taylor, Jamie Michael</i>	<b>APDE</b>	<b>AA</b>
<i>Vitali, Silvia</i>	<b>MP</b>	<b>SP</b>
<i>Zalczer, Sylvain Ezechiel Jerome</i>	<b>MP</b>	<b>QM</b>

**PHD STUDENTS**

	RESEARCH AREA	RESEARCH LINES
<i>Abanda, Amaia</i>	<b>DS</b>	<b>ML</b>
<i>Alonso, Ioseba Iñaki</i>	<b>DS</b>	<b>ML</b>
<i>Álvarez, Verónica</i>	<b>DS</b>	<b>ML</b>
<i>Anam, Vizda</i>	<b>M3A</b>	<b>MTB</b>
<i>Arza, Etor</i>	<b>DS</b>	<b>ML</b>
<i>Beñaran, Iker</i>	<b>DS</b>	<b>ML</b>
<i>Bonifazi, Giulio</i>	<b>M3A</b>	<b>MCEN</b>
<i>Camarasa, Miguel</i>	<b>APDE</b>	<b>WAVE</b>
<i>Canto, Javier</i>	<b>APDE</b>	<b>HA</b>
<i>Cañizares, Manuel</i>	<b>APDE</b>	<b>HA</b>
<i>Caro, Felipe Vinicio</i>	<b>CM</b>	<b>SIWP</b>
<i>Ceuca, Razvan-Dumitru</i>	<b>APDE</b>	<b>AA</b>
<i>Conte, Martina</i>	<b>M3A</b>	<b>MTB</b>
<i>Dahlenburg, Marcus</i>	<b>MP</b>	<b>SP</b>
<i>Dancheva, Tamara</i>	<b>CM</b>	<b>CFDCT</b>
<i>de la Bodega Domingo-Aldama, Javier</i>	<b>MP</b>	<b>STAG</b>
<i>Echeverría, Marina</i>	<b>M3A</b>	<b>MTB</b>
<i>Girier, Guillaume</i>	<b>M3A</b>	<b>MCEN</b>
<i>Hernández, Maria Alejandra</i>	<b>DS</b>	<b>AS</b>
<i>Kobeaga, Gorka</i>	<b>DS</b>	<b>ML</b>
<i>Pallarés, Irma</i>	<b>MP</b>	<b>STAG</b>
<i>Parga, Martín</i>	<b>M3A</b>	<b>MSLMS</b>
<i>Pérez, Diana Marcela</i>	<b>DS</b>	<b>AS</b>
<i>Rajain, Kanika</i>	<b>CM</b>	<b>SIWP</b>
<i>Rodríguez, Oscar Alberto</i>	<b>CM</b>	<b>SIWP</b>

### 3.1.1. RESEARCHERS

#### PHD STUDENTS

	RESEARCH AREA	RESEARCH LINES
<i>Segovia, José Ignacio</i>	<b>DS</b>	<b>ML</b>
<i>Shirazi, Abolfazl</i>	<b>DS</b>	<b>ML</b>
<i>Uriarte, Carlos</i>	<b>CM</b>	<b>SIWP</b>
<i>Zaballa, Onintze</i>	<b>DS</b>	<b>ML</b>
<i>Zumeta, Lore</i>	<b>DS</b>	<b>AS</b>

#### RESEARCH TECHNICIANS

	RESEARCH AREA	RESEARCH LINES
<i>Bondugula, Kartheek Reddy</i>	<b>DS</b>	<b>ML</b>
<i>Boujaada, Ahmed</i>	<b>DS</b>	<b>ML</b>
<i>Brarda, Francesco</i>	<b>M3A</b>	<b>MSLMS</b>
<i>Buoncompagni, Filippo</i>	<b>DS</b>	<b>ML</b>
<i>Diaz Tajuelo, Adrian</i>	<b>DS</b>	<b>ML</b>
<i>Gago, Imanol</i>	<b>DS</b>	<b>HO</b>
<i>García de Beristain, Imanol</i>	<b>CM</b>	<b>CFDMS</b>
<i>Giugliano, Luigi</i>	<b>DS</b>	<b>ML</b>
<i>Grieder, Andrew Carl</i>	<b>M3A</b>	<b>MSLMS</b>
<i>Guerrero, Claudia</i>	<b>DS</b>	<b>ML</b>
<i>Miller, William</i>	<b>DS</b>	<b>ML</b>
<i>Monsalve, Abelardo Enrique</i>	<b>DS</b>	<b>AS</b>
<i>Nagar, Lorenzo</i>	<b>M3A</b>	<b>MSLMS</b>

## RESEARCH TECHNICIANS

	RESEARCH AREA	RESEARCH LINES
<i>Otero, Marta</i>	<b>DS</b>	<b>AS</b>
<i>Peña de los Santos, Carlos Javier</i>	<b>DS</b>	<b>AS</b>
<i>Senhaji, Kaoutar</i>	<b>DS</b>	<b>ML</b>
<i>Strugaru, Magdalena</i>	<b>CM</b>	<b>SIWP</b>
<i>Uranga, Anton</i>	<b>DS</b>	<b>AS</b>



## 3.2.

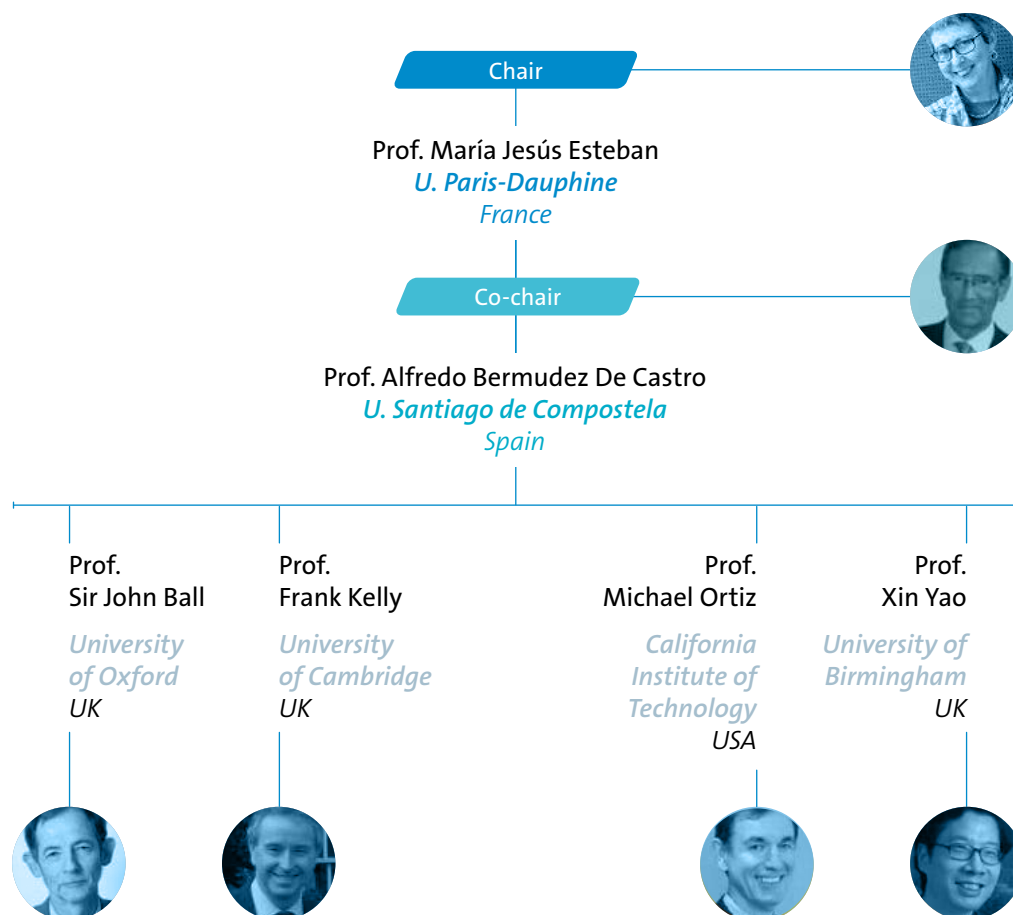
### BCAM SCIENTIFIC ADVISORY COMMITTEE

The Scientific Committee is an external and strategic advisory council of BCAM made up of internationally recognized researchers in mathematics.

They provide an independent view of BCAM's researchers and activities.

This committee meets once a year to monitor the development of the center's strategic plan, provide advice on different topics and validate the results obtained.

The composition in 2020 was as follows:



## 3.

The composition of the BCAM Scientific Advisory Committee will be updated in 2021.

## 3.3.

### ADMINISTRATIVE STAFF

Benítez, Miguel A.	<i><b>Project Manager</b></i>
Díaz, Irune	<i><b>Management Assistant</b></i>
Dose, Jana C.	<i><b>Management Assistant</b></i>
Elespe, Irantzu	<i><b>Management Assistant</b></i>
Gómez, Lorea	<i><b>General Manager</b></i>
González, Ainara	<i><b>Project Manager</b></i>
Hernández, Idoia	<i><b>Management Assistant</b></i>
Hernández, Olatz	<i><b>Communication Manager</b></i>
Mena, Nerea	<i><b>Project Officer</b></i>
Onaindia, Aitor	<i><b>IT Manager</b></i>

## 3.4.

### WOMEN AT BCAM



*Maria Xose Rodriguez*

*Ikerbasque Research Fellow*

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When I look back from where I am now, an Ikerbasque Research Fellow at the BCAM, I feel somehow surprised. I always liked and enjoyed Math when I was a child, but I never thought about becoming a researcher. It was not until much, much later, that I realised that I wanted to do research. It was not then a vocational decision but a slow process; it took me some time. As said, when I finished my undergraduate studies in Math, it didn't cross my mind to do a PhD. There must be several reasons for that, but I guess that the main one was that I thought I was not good enough. Thus, I started my professional career in the private sector. I first got a training scholarship in a Galician computer consulting company, where I worked for eight months as a programmer and developer of computer applications.

Later on, I spent another four years working, in different roles, in another company in the sector. It was a period in which I learned a lot, and it undoubtedly had an important impact on my posterior research career; I still dedicate a significant part of my time to software developments. However, at a certain point, I started to miss a more mathematical or statistical component in the work I was doing; I still wanted to apply what I had studied! So, I decided to take the PhD courses in Statistics. Once again, it did not cross my mind to do the PhD, but I saw it as a "simple" way to get back in touch with Statistics after some years. During that time, I combined the work in the company with the PhD courses, but then the possibility of doing a master's degree in Biostatistics came up, and I jumped into the pool. I quit my job and dedicated myself to retraining. And so, just like that, I was bitten by the research bug and decided to do the PhD.

And, since then, I have been very lucky to have been able to work as a researcher. What I have learn during this journey is that there is no need to be bright to do research. Other skills are more important: perseverance, curiosity, a pinch of creativity. It indeed is an absorbing and demanding profession. You are constantly faced with new challenges that may be frightening but also make you keep growing. And although I believe that it is a "hard" profession (not harder than many others), we are privileged since we can dedicate ourselves to what we are passionate about. And it is never too late.





### *Maira Aguilar*

*Marie Curie Fellow and Ikerbasque Researcher  
Research line leader*

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Hi, I am Maíra Aguilar and I am a biologist by training. I hold a double PhD degree in Life Sciences, from the Vrije Universiteit Amsterdam, and in Biology, with specialty in population Biology, from Universidade de Lisboa, Lisbon. Despite my background experience in laboratory and field epidemiology, I have been working in applied mathematics during the last 12 years, in close collaboration with laboratories and bureaus of epidemiology.

I have a multidisciplinary research profile. I am trained in disease epidemiology, nonlinear dynamics and biostatistics and my research interest addresses significant mathematical problems and fundamental questions in biology, crossing the different epidemiological areas of infectious diseases, with a special focus on public health epidemiology.

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I am currently the Mathematical and Theoretical Biology Group leader at the Basque Center for Applied Mathematics (BCAM). Before joining BCAM, I was a Marie Skłodowska-Curie Fellow at the Department of Mathematics of Università di Trento in Italy, working on my project “On the Origin of Complex Dynamics in Multi-strain Models: Insights for Public Health Intervention Measures” (COMPLEXDYNAMICS-PHIM), which was focused on dynamical systems theory, where I was studying the origin of the chaotic dynamics in multi-strain epidemiological models. As an active member of the Basque Country Modeling Task Force, assisting the Basque Health Managers and the Government of the Basque Country during the COVID-19 responses, my project was extended project’s scope has been extended to include research on the #COVID19 pandemic.

But I am more than just a scientist. I am also a mother (two daughters, Lara and Taís) and despite all the difficulties along my career path, I can say that I am very happy working in an excellent scientific environment, ready to new challenges!



### **Judit Muñoz**

*Postdoctoral Fellow  
Basque Government fellow*

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When it comes to share my testimony about being a woman and researcher in mathematics, I need to make a distinction. As a postdoc today, after a long 10-year mathematical journey, I think I share the same qualities as most of my colleagues: passionate about my work and terribly stubborn. I feel incredibly lucky to be part of a scientific community and research center that continuously enhance all my career prospects. I could not be more grateful for all the opportunities I have been given to grow professionally.

As a woman, I would describe my experience in research very similar to solving a mathematical problem: evenly challenging and exciting. First, it is challenging because we need to face every day the sad reality of being a clear minority even having the same career opportunities as our male peers. The lack of women referents in science and the historically belief that we are not made for this job, is still very present in our society. However, it is exiting to know that now is our turn to change gears on this situation, give visibility to women in science and become the inspiration for future generations. In that sense, I think we are following the right path.



*Christina Schenk*

*Postdoctoral Fellow*

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I have always had many interests reaching from languages to natural sciences math being one of my favorite subjects. While considering other career paths I realized that I was missing math. I recalled my high school teacher's advice that I would be the right person to study math and decided to give it a try. Although it might not have been the easiest path or maybe exactly because of that, I loved it and still enjoy being a mathematician. During my studies, I realized that I like theoretical mathematics but that for me it is very important to make a direct impact with the mathematical investigations performed as well, such that my math majors became numerical mathematics and optimization. I am grateful to many people and for all the opportunities that have led me to where I am now but I have also perceived many discouragements along the way.

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Mathematics can be useful for all kind of different real-world problems. This brings along the opportunity to not only learn more about other mathematical fields or dive deeper into a particular topic but other disciplines as well, such that I have already learned a lot in the fields of medicine, fermentation, pharma, chemistry, and more recently also biology. Within my current postdoctoral role, I mostly work at the intersection of mathematics and synthetic biology. On the mathematical side, we focus on mathematical modeling and design via Bayesian inference, Monte Carlo, and machine learning approaches. Our research can make an impact in many applications, such as biofuel production, the treatment, and diagnostics of human diseases, synthetic food production, among others.

My everyday work as a researcher includes coding, reading, writing, mathematical analysis, meetings, and participating and speaking in seminars and conferences. In non-COVID times, traveling is also part of my job. What I like the most about this career path is that I have the opportunity to interact with very diverse groups of people, the continuous process of learning and that my research can make an impact on critical topics related to the sustainability of our Planet.

“Life is not easy for any of us. But what of that? We must have perseverance and above all confidence in ourselves. We must believe that we are gifted for something and that this thing must be attained.” - Marie Curie



**Lore Zumeta**

*PhD Student  
Predoc Severo Ochoa 2018*

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When I was little girl I loved different subjects at school, and Math was among the ones I most enjoyed most and I was keen on. But, when I was finishing the high school about to choose a career path, it was not until the last moment that I decided that I wanted to study Mathematics. I may have doubted whether this degree would be too difficult or beyond my reach. I eventually convinced myself -after knowing the experience of people that studied Maths-, and nowadays, I don't regret that decision at all. At university I discovered a new field of knowledge, that was broader and more diverse in topics, than I originally believed what Math was. As years passed, it was the applied part of mathematics that appealed to me the most. I feel that, during these years up to the present, the support of the people close to me has been essential to carry out the studies and somehow help taking decisions.

I obtained my Bachelor's degree in Mathematics in July 2016 at the University of the Basque Country (UPV/EHU), and did my Master's degree in Statistics and Operations Research (MESIO UPC-UB), by the Polytechnic University of Catalonia and the University of Barcelona, during 2016-2018. At present, I am doing a PhD at the Basque Center for Applied Mathematics (BCAM) in the Applied Statistics group. I study statistical models that can help to better understand the mechanism of injury, models that can identify possible risk factors and thus contribute to clinical and sports practice.



***Onintze Zaballa***

*PhD Student  
Basque Government fellow*

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It is difficult for me to think about who were the female scientists that inspired me at school, but in the last decade things have changed a lot and women in science are getting the social recognition they deserve.

Over my university years and since I have started my PhD in maths, I have met outstanding female teachers and leading scientists that have become my role models because of their achievements despite any circumstance and their fight to be where they are today. It is clear that we have a long way to go towards reaching gender equality in science, but a big community of researchers is working hard to remove the typical gender roles and stereotypes.

My advice to other girls and women is to pursue what they want to be or make in life, work on their passions, and always keep believing in themselves. We should not forget that unfortunately in many countries this is not so easy but I believe that we can make this happen everywhere in the world and show people that it is also worth do it. Science is for everyone.



# FUNDING

4.

## HIGHLIGHTED GRANTS

Throughout this year BCAM researchers have developed a wide range of projects at regional, national and international level. It is interesting to go further on some of the grants with higher international projection, to give an overview of their main scientific objectives and impact:



### **669689 – HADE Harmonic Analysis and Differential Equations: New Challenges (H2020)**

**Funded by:** ERCEA-Advanced Grants 2014

**Duration:** 01/12/2015 - 30/11/2021

**Principal Investigator:** Prof. Luis Vega

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This project sets forth cutting-edge challenges in the field of Mathematical Physics that will be solved within a common framework by making novel use of classical tools of Harmonic Analysis such as Oscillatory Integrals and Trigonometric Sums, the Cauchy operator, and the so-called Carleman estimates. Three aspects will be covered:

1. Vortex Filament Equation (VFE), 2. Relativistic and Non-relativistic Critical Electromagnetic Hamiltonians and 3. Uncertainty Principles (UPs) and Applications. The interaction of vortex filaments is considered a key issue in order to understand turbulence which is seen by many as the most relevant unsolved problem of classical physics. VFE first appeared as an approximation of the dynamics of isolated vortex filaments. I want to understand what happens when at time zero the filament is a regular polygon. Preliminary theoretical arguments together with some numerical experiments suggest that the different corners behave like different vortex filaments that interact with each other in such a way that the dynamics seem chaotic. I will prove the so-called Frisch-Parisi conjecture, showing that behind this chaotic behavior there is an underlying algebraic structure that controls the dynamics.

The Dirac equation, despite being one of the basic equations of Mathematical Physics, is very poorly understood from an analytical point of view. I will use the classical Cauchy operator in a modern way to explain some key Hamiltonian systems such as the MIT bag model for quark confinement.

UPs are at the heart of different fields like Quantum Mechanics, Harmonic Analysis, and Information Theory. We want to use a new approach to analyze modern versions of UPs that are not well understood. In order to do this, I will look at the problem from the point of view of partial differential equations making novel use of the Carleman estimates. This analysis will also be extended to the discrete setting where even classical UPs such as the one by Hardy are not solved yet.

One of the most interesting conclusions deduced from the project, is the great usefulness of Fourier Analysis in the study of partial differential equations (PDEs) "even" in the XXI century. This century is largely about the study of non-linear PDEs where the superposition principle, one of the key building blocks of Fourier Analysis, that goes back at least to the early 1800's, cannot be applied. However, the development of novel techniques of multilinear analysis has bridged this difficulty by opening up a vast panorama of basic research on hitherto intractable problems. We explore using these techniques different aspects of fluid mechanics, and both relativistic and non-relativistic quantum mechanics.

The main applications in the short and medium term will be in the field of mathematics itself and, we hope, also in some relevant physical questions such as the study of fluid turbulence or the possibility of confinement of relativistic quantum particles.

In the long term, both the turbulence and confinement issues must have applications in the real world. Since they are basic questions, these possible applications, which we do not even glimpse today, can have a strong impact on daily life. For example, the understanding of the basic rules that govern turbulent fluids will eventually allow to be much more effective in their manipulation and in the construction of devices that have to deal with them as planes, cars, or simple air conditioning equipment.

#### **About the PI**

*Luis Vega is Professor of Mathematics at the UPV/EHU since 1995 and has been visiting professor at several international universities. Scientific Director of BCAM from 2014 to 2019, he is currently the Principal Investigator of the Severo Ochoa accreditation granted to the centre. He has been vice-president of the Spanish Royal Mathematical Society (RSME) and member of the Spanish Society of Applied Mathematics (SEMA), and is currently Officer of the International Council of Industrial and Applied Mathematics (ICIAM). He is also a member of the European Academy of Sciences and of the Spanish Real Academia de Ciencias. He also leads the HADE project (Harmonic Analysis and Differential Equations: new challenges) funded by the European Research Council.*





## **862025-ADAM^2 Analysis, Design, And Manufacturing using Microstructures (H2020)**

**Funded by:** FETOPEN – 01 – 2019

**Duration:** 01/01/2020 - 31/12/2023

**Principal Investigator:** Dr. Michael Bartoň

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ADAM^2 project is about the whole Analysis-Design-And-Manufacturing pipeline of curved object using Microstructures. To manufacture a complex curved 3D shape, such as a turbine blade or a 3D scanner portable mechanism, for example, requires powerful and user-friendly tools that operate under tight synergy and efficiently and automatically create 3D artefacts. The evolution of new manufacturing technologies such as multi-material 3D printers gives rise to new type of objects that were not possible to think of a decade ago. The most interesting feature is to design, analyze (= optimize), and manufacture objects that may consist of considerably less, yet heterogeneous, material, consequently being porous, lighter and cheaper, while having the very same functionality as the original object when manufactured from one single solid material.

There are several projects that aim to further exploit results of ADAM^2, for example custom-shaped (and microstructured) shoe-soles and/or shoe-insets that will be softer and airy and the pipeline offers custom-shaped design and manufacturing, that can serve e.g. to podiatric and/or diabetic patients. Another promising medical application is the prosthesis manufacturing, where one seeks light—weight objects with the very same functionality as if they were manufactured from a single (homogenous) material.

## **764979 – ENABLE European Network for Alloys Behaviour Law Enhancement (H2020)**

**Funded by:** MSCA – ITN -2017 Marie Skłodowska-Curie

**Duration:** 01/02/2018 - 31/01/2022

**Principal Investigator:** Dr. Michael Bartoň

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The ENABLE is an ETN (European Training Network) project that aims to train early-stage researchers in what is referred to as an outstanding challenge for the future of manufacturing: developing novel solutions for forecasting and mastering processes relevant for all factories using metallic alloys. ENABLE proposes a complete rethink of the usual process simulation method by developing innovative multiscale (from microscopic to macroscopic scales), multi-physical (strong thermomechanical and microstructural couplings) and multi-level advanced simulations. BCAM's main involvement are numerical simulations and computational speed up.

The result of ENABLE can be used for development of new alloys that can have better thermal properties. This can impact the aeronautic industry, for example, where aircraft engine components are desired to be light yet to have high thermal resistance.

The ENABLE Project is also fully aligned with several of the research priorities defined in relevant European initiatives, such as the FoF - Factories of the Future PPP (public-private partnership). Aspects related to process modelling are addressed both at current work-programmes for the FoF calls and at the EFFRA (European Factories of the Future Research Association) roadmap. One of the main issues is zero-defect manufacturing. The modeling pipeline of ENABLE should contribute to this long-term European goal by detecting possible manufacturing defects already in the modeling/simulation stage.

### ***About the PI***

*Michael Bartoň received his Ph.D. degree in computational and applied mathematics from the Charles University in Prague, Faculty of Mathematics and Physics, in 2007. He works as an Ikerbasque Research Associate & Ramon y Cajal Fellow, co-leading the research line of the Simulation of Wave Propagation at BCAM. His research interests span geometric modelling and manufacturing, computer aided design, and isogeometric analysis.*



**777778 – MATHROCKS Multiscale Inversion of Porous Rock Physics using High-Performance Simulators: Bridging the Gap between Mathematics and Geophysics (H2020)**

**Funded by:** MSCA-RISE-2017 Marie Skłodowska-Curie

**Duration:** 01/04/2018 - 31/03/2023

**Principal Investigator:** Dr. Seyed Ali Hashemian

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The main objective of this Marie Curie RISE Action is to improve and exchange interdisciplinary knowledge on applied mathematics, high performance computing, and geophysics in order to be able to better simulate and understand the materials composing the Earth's subsurface. This is essential for a variety of applications such as CO<sub>2</sub> storage, hydrocarbon extraction, mining, and geothermal energy production, among others. All these problems have in common the need to obtain an accurate characterization of the Earth's subsurface. To achieve this goal, several complementary areas are studied, including the mathematical foundations of various high-order Galerkin multiphysics simulation methods, the efficient computer implementation of these methods in large parallel machines and GPUs, and some crucial geophysical aspects such as the design of measurement acquisition systems in different scenarios.

The most interesting features of the project are (a) to produce excellent research in geophysical exploration, (b) to train interdisciplinary experts in Mathematics, HPC, and Geophysics, (c) to transfer knowledge between industry and academia, (d) to widely disseminate our results to the society at large, (e) to form new talent, and (f) to make the MATHROCKS network sustainable beyond the duration of this RISE Action.

The technological needs of geophysical exploration applications are continuously evolving (e.g., simultaneous CO<sub>2</sub> sequestration and oil-extraction, or characterization of artificially generated hydro-fractures for enhanced hydrocarbon recovery). Modern measurement acquisition systems provide further capabilities to characterize the Earth's subsurface properly (e.g., geosteering logging instruments incorporating deep azimuthal resistivity sensors). These technological advances require a quantitative increase in the resolution currently obtained in simulations and interpretation (inversion) of the recorded measurements. Specifically: for sonic measurements (both on-surface seismic and borehole acoustics), for electromagnetic measurements, for nuclear, fluid-flow, and other physical measurements.

Exploration of the Earth's subsurface is fundamental to our society. The lack of a detailed map of the Earth's subsurface prevents us from massively storing CO<sub>2</sub> underground, a practice that is being increasingly used to attenuate global warming. In the area of hydrocarbon exploration, oil companies invest tens and even hundreds of millions of euros per reservoir to construct subsurface maps. Even such costly endeavors often fail to provide an accurate assessment of the existing hydrocarbon reserves. Other applications that will benefit from a precise characterization of the Earth's subsurface are: (a) earthquake prediction and seismic hazard estimation; (b) mining; (c) geothermal energy production; (d) mine detection; and (e) large construction projects.

The oil company REPSOL is part of this project. We will also show the progress of our work to other European-based oil companies, and mining companies. For instance, TOTAL has ongoing contracts with some RISE Action partners, namely, the Inria and UTEXAS groups. We will also seek to establish collaboration with other smaller corporations and institutions that require interpretation of geophysical measurements for their daily activities.

#### **About the PI**

*Ali Hashemian is a Postdoctoral Fellow at BCAM – Basque Center for Applied Mathematics (Bilbao, Spain). He is currently the Principal Investigator (PI) at BCAM in H2020 European Union RISE Project MATHROCKS. Ali's research lines include interconnections of different disciplines: Computational Mechanics, Computational Geometry, Computer-Aided Design/Manufacture/Engineering (CAD/CAM/CAE), Finite Element/Volume Methods (FEM/FVM), Isogeometric Analysis (IGA), and Engineering Optimization. He also has industrial backgrounds in the Automotive Industry, CNC Machining, and Turbomachinery.*



**956325 – ASTROTECH Disruptive materials, technologies & approaches to unravel the role of Astrocytes in brain function and dysfunction: towards to Glial interfaces (H2020)**

**Funded by:** MSCA-ITN-2020 M Marie Skłodowska-Curie

**Duration:** 01/11/2020 - 31/10/2024

**Principal Investigator:** Dr. Maurizio de Pitta

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The project consists on developing early markers for the preclinical diagnosis of Alzheimer's disease. It is a vastly multidisciplinary project that exploits different modeling tools from Physics and Mathematics to harness the complex biology of Alzheimer's disease and develop predictors for its progress, from early onset to later stages of cognitive decline. Arguably, it is pioneering the use of mathematical and computational tools in the realm of cognitive decline that has traditionally been ascribed to medical doctors.

In the future, the approach that it is being design applied to Alzheimer's diagnosis, can in principle, be extended to any neurodegenerative brain disorder and even any pathology beyond the brain itself. In practical terms, the research develops criteria (by mathematical models) that can assist medical doctors and psychologists diagnose and treat cognitive deficits effectively. The ultimate goal is to develop a hierarchical understanding of Alzheimer's.

***About the PI***

*Maurizio de Pitta is La Caixa Junior Leader fellow on computational neuroscience in the Mathematical, Computational and Experimental neuroscience research line. His expertise is on neuron-glia interactions in the healthy and diseased brain. In addition, he uses multi-disciplinary approaches at the cross-roads of Physics and Computer Science, and also collaborates with biologists, engineers and medical doctors, to harness the complexity of neuron-glia signaling, from the subcellular realm to Systems' levels. He is the Principal Investigator of the ASTROTECH Consortium, and member of the CliSyNe Network.*



## **832332 – MinSol – PDEs Minimal Solutions to nonlinear systems of PDEs (H2020)**

**Funded by:** MSCA-IF-SF-2018 Marie Skłodowska-Curie

**Duration:** 01/12/2019 - 30/11/2021

**Marie Curie Fellow:** Panayotis Smyrnelis

**Advisor:** Prof. Arghir Zarnescu

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The aim of my project is to provide a systematic study of minimal solutions for a large class of nonlinear systems of partial differential equations. The first part focuses on phase transition problems described by the Allen-Cahn system. This is a hot and difficult topic linking partial differential equations with the theory of minimal surfaces. In the second part, my focus is on the Painlevé equation which plays a crucial role in areas as diverse as random matrices, integrable systems, and superconductivity. My objective is to classify and investigate the minimal solutions of Painlevé-type systems in low dimensions. These have direct applications in the study of vortices in liquid crystals and Bose-Einstein condensates.

Finding the optimal solution that minimizes the “energy” is one of the relevant aspects of the project. Indeed, in most physical phenomena, the “minimal” solution is preferred among all possible solutions. This is the principle of least action.

About the applications in the future, the project will provide a better understanding of the structure of light vortices by developing the mathematical theory of light-matter interaction in liquid crystals. Manipulating light vortices has applications in quantic computation, telecommunications, and astronomy (improvement of images, detection of exoplanets).

### ***About the PI***

*Panayotis Smyrnelis was awarded a Marie Skłodowska-Curie Individual Fellowship hosted by the Basque Center for Applied Mathematics. He is working as a researcher in the Applied Analysis research line and his areas of interest include Elliptic systems of PDEs, Nonlinear ODEs, Calculus of Variations, Harmonic maps, Applications in Physics (nonlinear optics, liquid crystals, superconductivity).*



**842536- AEROSIMULAT High-performance aerodynamics and aeroacoustics simulations of the new generation of high-speed gas turbines via high-order Galerkin methods (H2020)**

**Funded by:** MSCA-IF-GF 2018 Marie Skłodowska-Curie

**Duration:** 01/09/2020 - 31/08/2023

**Marie Curie Fellow:** Dr. Margarida Moragues

**Advisors:** Prof. Spencer Sherwin and Dr. Simone Marras

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The main goal of the project is the high-fidelity simulation of jet noise, which is the noise emitted by the turbulent jet coming out from an aircraft engine. Jet noise will be computed from the solution of the turbulent compressible flow that characterizes the jet, and extrapolated to the far field in order to evaluate the magnitude of this noise in the surrounding airport areas.

The interesting features of this project are the advance in the understanding of jet noise simulation, as well as its contribution to the development of the open-source software platform Nektar++. It is also very interesting the international and multidisciplinary atmosphere in which the project takes place.

The main long-term application of the project is its contribution to the reduction of jet noise. It will also improve the knowledge concerning the best simulation practices of jet noise using high-order spectral element methods on unstructured meshes. In addition, the project will provide methodologies and software development that will advance in the prediction of jet noise and shorten the distance between academia and industry in that direction.

The results of the project could contribute to the design of quieter aircraft engines, and thereby help minimize the associated negative environmental and health impacts of aircraft noise.

**About the PI**

*Margarida Moragues is a Marie Skłodowska-Curie Action Individual Fellowship (MSCA-IF-GF) Researcher at the Basque Center for Applied Mathematics (BCAM), and Visiting Researcher at the New Jersey Institute of Technology (USA). She received her Ph.D. in Computational Mathematics at the Polytechnic University of Catalonia (UPC), jointly with the Barcelona Supercomputing Center (BSC). Her area of expertise is computational fluid dynamics, finite element methods, the Navier-Stokes equations.*



**101021893 – ViBRheo Desing of a Virtual Blood Rheometer for Thrombotic Process Characterization (H2020)**

**Funded by:** MSCA-IF-SF-2020: Marie Skłodowska-Curie

**Duration:** 01/01/2022 - 31/12/2023

**Marie Curie Fellow:** Dr. Nicolás Moreno

**Advisor:** Prof. Marco Ellero

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The project aims to provide a heterogeneous multiscale framework for modelling clot formation in blood, occurring both in vivo and in vitro. The heterogeneous multiscale approach will have the advantage of capturing microscopic fluid effects at the macroscopic length scales, with a lower cost than solving the microscales in the whole domain. Additionally, in terms of implementation allows the use of various numerical algorithms that exploit the knowledge at both micro and macro-scales. The project will provide information about how chemical, geometrical, and fluid transport features may affect the blood coagulation cascade.

The project will tackle COVID-19-related coagulopathies as the core of the investigation. The objective is to construct a virtual rheometer to characterize and diagnose abnormal coagulation patterns in critically-ill patients. Moreover, the project will attempt to elucidate the dominant features triggering disseminated intravascular coagulation (DIC) in severe-ill covid-patients.

As the main feature of this project is the use of viscoelastic characterization of whole blood and plasma. This represent an excellent integral indicator, incorporating implicitly several molecular factor. Moreover, it relies on rheological test that can be simpler to use and direct to interpret providing a clear link between patho-kinetics and macroscopic flow response.

The project will count with the support of international and local collaborators. This will establish a multidisciplinary team with expertise in medicine, biophysics, computational modelling, and microfluidics.

The generated tool will help in the early diagnose and monitoring of coagulopathies related to COVID-19. The outcome of this project will serve as a virtual twin of existent diagnostic techniques for coagulopathies, understanding the different mechanisms leading to clot formation over large temporal scales. Furthermore, it will shed light into novel rheological biomarkers and microdevices.



Once the project is finished it will contribute to society as a tool for medical diagnose and gaining general understanding on blood related diseases. This tool can streamline a continuous diagnosis to assess the proper prophylactic strategy. Furthermore, in the long terms, it aims to improve our readiness to face new pandemics.

### ***About the PI***

*Nicolás Moreno obtained his Ph.D. from King Abdullah University of Science and Technology (KAUST) in Environmental Science and Engineering investigating the formation of isoporous membranes. He is a Marie Skłodowska-Curie Action Individual Fellowship (MSCA-IF-GF) Researcher at BCAM, and his research focuses on the flow simulation of colloids of different shapes in micro- and nanochannels.*



**101017984 - GEODPG Space-time DPG methods for partial-differential equations with geophysical applications (H2020)**

**Funded by:** MSCA-IF-GF-2020: Marie Skłodowska-Curie

**Duration:** 01/01/2022 - 31/12/2024

**Marie Curie Fellow:** Judit Muñoz

**Advisors:** Prof. Leszek Demkowicz and Prof. David Pardo

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In this project, the main objective is to design fast, stable, and accurate numerical methods to solve wave propagation problems. We will develop a software to simulate the solution of transient Partial Differential Equations employing stable time-marching schemes supporting classical and goal-oriented adaptive strategies. These simulations will enable to improve the characterization of the Earth's subsurface and its application to CO<sub>2</sub> long-term storage.

One of the most interesting parts of the project is that is a multidisciplinary research project based on the collaboration of international academic communities and the industry. Moreover, the fellowship will allow the candidate to work in a world top university with the best researchers in the area improving her future career prospects.

The final stage of the project is to apply the developed simulation methods to geophysical applications. The final goal is to transfer the results directly to the industry and apply the simulation method to solve real engineering problems in geophysics like the characterization of the Earth subsurface.

The goals of the project are mostly academic with a final application in the industry. In addition, during the fellowship the candidate will perform outreach activities in order to transfer the results of the project to general audiences and rise awareness of the importance of scientific research in our society.

***About the PI***

*Judit Muñoz completed her PhD in 2019 at the University of the Basque Country (UPV/EHU). She has a M.S. in Mathematical Modelling and Research, Statistics and Computing and a B.S. in Mathematics by the same university. During her PhD, she worked on numerical methods for transient partial differential equations (mostly on advection-dominated-diffusion equation, wave propagation problems and Stokes flows) including finite element and finite difference methods, space-time variational formulations, goal-oriented adaptivity, error estimation, and residual minimization methods. She obtained a three-year postdoctoral fellowship from the Basque Government to work at BCAM within Prof. David Pardo's group. The first two years of the fellowship, she will work at the "Oden Institute for Computational Engineering and Sciences" at the University of Texas at Austin within the group of Prof. Leszek Demkowicz.*



## **Early Prognosis of COVID-19 Infections via Machine Learning**

**Funded by:** Axa Research Fund

**Duration:** 01/10/2020 - 30/09/2023

**Principal Investigator:** Dr. Santiago Mazuelas

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Differently from other diseases, COVID-19 infections result in particularly distinct outcomes: certain patients remain asymptomatic during the infection, some other experience moderate symptoms for a few weeks, and yet others suffer acute or even critical complications. Wrong assignments of care's type for COVID-19 patients may cause fatal outcomes, and lack of isolation measures for asymptomatic infections may increase COVID-19 propagation among the population. These facts pose a key challenge for COVID-19 containment since the most pertinent countermeasures at the time of infection's detection are markedly different for each type of patients.

The project "Early Prognosis of COVID-19 Infections Via Machine Learning" develops machine learning techniques for the early prognosis of COVID-19 infections that predict infections' future severity using health data obtained soon after the detection.

The algorithms developed in the project can be used by medical personnel or public health stakeholders to take timely decisions that result in favorable outcomes. The machine learning techniques developed in this project can enable remarkable improvements in the way healthcare systems operate. In particular, they can serve to improve the way in which medical and public health decisions are taken to treat and manage COVID-19 infections. In addition, the learning algorithms developed in the project can also enable healthcare systems to better categorize risks of individuals. More broadly, the learning methodologies developed in the project can be leveraged to develop machine learning methods that assess the likelihood of future adverse general events based on data obtained ahead of time.

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### **About the PI**

*Santiago Mazuelas received the Ph.D. in Mathematics and Ph.D. in Telecommunications Engineering from the University of Valladolid, Spain, in 2009 and 2011, respectively. Since 2017 he has been Ramon y Cajal Researcher and Ikerbasque Fellow at the Basque Center for Applied Mathematics (BCAM). His general research interest is the application of mathematics to solve practical problems, currently his work is primarily focused on statistical signal processing, machine learning, and data science.*



## **EFA362/19 – PIXIL Pyrenees Imaging eXperience: an International network**

**Funded by:** Interreg POCTEFA

**Duration:** 01/09/2019 - 30/04/2022

**Principal Investigator:** Prof. David Pardo

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The Earth's subsurface holds natural resources which are fundamental for regional development. Obtaining accurate images of water, mineral and energy sources deep below the surface is a key step for their management and exploitation. Imaging is a branch of geophysics that allows us to obtain detailed maps, or images, of the Earth's interior, this is achieved through the analysis of the deformations and electromagnetic fields measured at the surface, similar to tomographic imaging of the interior of the human body.

This analysis is carried out by complex algorithms running in high-performance computers. The transborder region between France and Spain hosts five top research institutions working on the three main topics that comprise the field of Subsurface Imaging: Geophysics, Applied Mathematics and Computer Science. The PIXIL project is a multidisciplinary, scientific and technological partnership across the national boundary, that aims to develop beyond-state-of-the-art tools that scrutinize the subsurface, with a special focus on encouraging the use of geothermal energy in the region. In the future, It will allow not only to determine better placement for geothermal energy production, but it will also generate a collaborative network with expertise in different geophysical-related issues.

The project will contribute to establishing the Pyrenees and neighbouring regions as a major technological hub in subsurface characterization, and this achievement expects to boost wealth and employment for the region, related to the extraction and management of natural resources. It will promote a better transition towards clean and sustainable energy production.

### **About the PI**

*David Pardo is a Research Professor at Ikerbasque, the University of the Basque Country UPV/EHU, and the Basque Center for Applied Mathematics (BCAM) at the Simulation of Wave Propagation research line. He received the B.S. degree in mathematics from the University of The Basque Country, Spain, in 2000, and the M.S. and Ph.D. degrees in computational and applied mathematics from The University of Texas at Austin, in 2002 and 2004, respectively. His research interests include computational electromagnetics, petroleum-engineering applications (borehole simulations), adaptive finite-element and discontinuous Petrov-Galerkin methods, multigrid solvers, deep learning algorithms, and multiphysics and inverse problems.*

$$(0, x) = u_0(x)$$

$$u_f(0, x) = u_1(x)$$

$\Omega$   
 $\Omega$

$$\int_0^T \int_{\Omega} |u_t(t, x)|^2 dx dt$$

~~$$\int_0^T \int_{\Omega} [u(t, x) + u_t^2(t, x)] dx dt$$~~

$$= \frac{1}{2} \|u_0\|_H^2 + \|u_1\|_L^2$$

$$H = \langle \mathbb{R}, \|u \rangle$$

Well-posedness



# 4.1.

## COMPETITIVE PUBLIC FUNDING

### 4.1.1.

EUROPEAN COMMISSION – HORIZON 2020 – EXCELLENCE PILLAR

#### 4.1.1.1. ERC (EUROPEAN RESEARCH COUNCIL)



##### ADVANCED GRANTS

- **Call:** ERC-2014-AdG
- **Project:** 669689 - HADE - Harmonic Analysis and Differential Equations: New Challenge
- **Funding:** 1.672.103€
- **Duration:** 01/12/2015 - 30/11/2021
- **Principal Investigator:** Luis Vega
- **Beneficiary:** Universidad del País Vasco - UPV/EHU, Third parties: BCAM

##### CONSOLIDATOR GRANTS

- **Call:** ERC-2013-CoG
- **Project:** 615655 - NMST - New Methods and interactions in Singularity Theory and Beyond
- **Funding:** 1.140.601€
- **Duration:** 01/05/2014, transferred to BCAM on 01/09/2015 - 30/04/2020
- **Principal Investigator:** Javier Fernández de Bobadilla

#### 4.1.1.2. FET OPEN



- **Call:** FETOPEN-01 2019
- **Project:** 862025 - ADAM^2 (H2020) Analysis, Design, And Manufacturing using Microstructures
- **Funding:** 356.740,00€
- **Duration:** 01/01/2020 - 31/12/2023
- **Principal Investigator:** Michael Bartoň



#### 4.1.1.3. MARIE SKŁODOWSKA-CURIE ACTIONS

##### RESEARCH NETWORKS INNOVATIVE TRAINING NETWORKS (ITN)

- **Call:** H2020-MSCA-ITN-2017
- **Project:** 764979 – ENABLE – European Network for Alloys Behaviour Law Enhancement
- **Funding:** 247.873€
- **Consortium:** Université de Bordeaux, ENS des Mines de Paris, ENIT, Lulea Tekniska University, Universidad del País Vasco - UPV/EHU, TECNALIA, SAFRAN S.A., SIRRIS
- **Duration:** 01/02/2018 - 31/01/2022
- **Principal Investigator:** Michel Bartoň

- **Call:** H2020-MSCA-ITN 2020
- **Project:** 956325 - ASTROTECH (H2020)  
Disruptive materials, technologies & approaches to unravel the role of Astrocytes in brain fuction and dysfunction: towards to Glial interfaces
- **Funding:** 250.904,88€
- **Consortium:** The Chancellor Masters and Scholars of the University of Cambridge, Ustav Experimentalni Mediciny Akademie Ved Ceske Republiky Verejna Vyzkumna Institute, Universite D'Aix Marseille, Istituto Nacional de Engenharia Biomedica, Universidad Degli Studio di Bari Aldo Moro, Fondazione Istituto Italiano di Tecnologia, Agencia Estatal Consejo Superior de Investigaciones Científicas, Avanzare Innovacion Tecnologica SL, Optoceutics APS
- **Duration:** 01/11/2020 - 31/10/2023
- **Principal Investigator:** Maurizio de Pitta

##### RESEARCH AND INNOVATION STAFF EXCHANGES (RISE)

- **Call:** H2020 - MSCA - RISE - 2017
- **Project:** 777778 – MATHROCKS – Multiscale Inversion of Porous Rock Physics using High-Performance Simulators: Bridging the Gap between Mathematics and Geophysics
- **Funding:** 765.000€
- **Consortium:** UPV/EHU, INRIA, BSC-CNS, UPF, PUC Valparaíso, Curtin Univ., Univ. Nacional de Colombia, PUC Chile, Univ. Central de Venezuela, Univ. de Buenos Aires, Macquarie Univ.
- **Duration:** 01/04/2018 - 31/03/2023
- **Principal Investigator:** Seyed ali Hashemian

#### 4.1.1.4. INTERREG POCTEFA



- **Call:** 3<sup>a</sup>
- **Project:** EFA212/16 PIXIL Pyrenees Imaging eXperience: an International network
- **Funding:** 117.000€
- **Duration:** 01/09/2019 - 30/04/2022
- **Consortium:** Barcelona Supercomputing Center (BSC), Universitat de Barcelona, Institut National de Recherche en Informatique et en Automatique (INRIA), RealTimeSeismic, Pole Avenia
- **Principal Investigator:** David Pardo

## 4.1.2.

### SPANISH STATE RESEARCH AGENCY

#### 4.1.2.1. EXCELLENCE ACREDITATION “SEVERO OCHOA”



- **Centre of Excellence:** “Severo Ochoa” SEV-2017-0718
- **Duration:** 01/07/2018 - 30/06/2022
- **Funded by:** Spanish Government - AEI
- **Principal Investigator:** Luis Vega
- **Funding:** 4,000,000€

#### 4.1.2.2. NATIONAL PLAN R&D 2017-2021



- **Call:** Projects R&D&i - Challenges 2019
- **Project:** PID2019-108111RB-I00 Real-time Inversion using Deep Learning Methods
- **Funding:** 136.004,00€
- **Duration:** 01/06/2020 - 31/05/2024
- **Principal Investigators:** David Pardo, Vincenzo Nava

- **Call:** Projects R&D&i - Challenges 2019
- **Project:** PID2019-107685RB-I00 Ensemble forecasting for predicting wildfire propagation
- **Funding:** 46.343,00€
- **Duration:** 01/06/2020 - 31/05/2023
- **Principal Investigator:** Gianni Pagnini



- **Call:** Projects R&D&i - Challenges 2019
- **Project:** PID2019-104488RB-I00 Manufacturing of curved objects via Path-design of custom-shaped tools
- **Funding:** 136.004,00€
- **Duration:** 01/06/2020 - 31/05/2023
- **Principal Investigators:** Michael Bartoň, Amaia Calleja

- **Call:** Projects R&D - G. Conocimiento 2019
- **Project:** PID2019-104927GB-C22 Geometric numerical integrators for quantum problems, celestial mechanics and monte carlo
- **Funding:** 64.977,00€
- **Duration:** 01/06/2020 - 31/05/2023
- **Principal Investigators:** Elena Akhmatskaya, Ander Murua

- **Call:**Projects R&D&i - G. Conocimiento 2019
- **Project:** PID2019-105058GA-I00 Unifying data processing via probabilistic transformations
- **Funding:** 40.656,00€
- **Duration:** 01/06/2020 - 31/05/2023
- **Principal Investigator:** Santiago Mazuelas

- **Call:** Projects R&D&i - G. Conocimiento 2018
- **Project:** PGC2018-094522-B-I00 Mathematical and numerical analysis of some partial differential equations and their applications
- **Funding:** 142.780,00€
- **Duration:** 01/01/2019 - 31/12/2021
- **Principal Investigators:** Luis Vega, Carlota Cuesta

- **Call:** Projects R&D&i - Challenges 2018
- **Project:** PGC2018-094528-B-I00 Interplays between Harmonic Analysis and Inverse Problems
- **Funding:** 57.717,00€
- **Duration:** 01/01/2019 - 31/12/2021
- **Principal Investigators:** Pedro Caro, Ioannis Parissis

- **Call:** Scientific equipment for research
- **Project:** RTI2018-093860-B-C21 Development of novel mathematical and experimental methodologies to control neuronal activity and dissect spatio-temporal neuronal codes
- **Funding:** 35.332,00€
- **Duration:** 01/01/2019 - 31/12/2021
- **Principal Investigator:** Serafim Rodrigues

- **Call:** Projects R&D&i - Challenges 2018
- **Project:** RTI2018-094595-B-I00 Virtual Rheological Analysis of Complex Shear Thickening Fluids
- **Funding:** 41.140,00€
- **Duration:** 01/01/2019 - 30/06/2021
- **Principal Investigator:** Marco Ellero

- **Call:** Projects R&D&i - Challenges 2017
- **Project:** MTM2017-82184-R Designed fluids: ferrofluids and beyond
- **Funding:** 34.969,00€
- **Duration:** 01/01/2018 - 30/09/2021
- **Principal Investigator:** Arghir Dani Zarnescu

- **Call:** Projects R&D&i - Challenges 2017
- **Project:** TIN2017-82626-R Efficient Management of the Electric Energy Consumption by Means of the Classification, Prediction and Clustering of Time Series
- **Funding:** 68.002,00€
- **Duration:** 01/01/2018 - 30/09/2021
- **Principal Investigators:** Aritz Pérez

- **Call:** Projects R&D&i - Challenges 2017
- **Project:** MTM2017-82379-R New contributions in semiparametric regression and applications in agricultural field trials, epidemiological risks assessment and marine ecology
- **Funding:** 38.841,00€
- **Duration:** 01/01/2018 - 30/06/2021
- **Principal Investigators:** María Xosé Rodríguez, Dae-Jin Lee

- **Call:** Scientific equipment for research
- **Project:** EQC2019-005376-P NEUROMATH LAB
- **Funding:** 111.224,41 €
- **Duration:** 01/01/2020 - 31/12/2021
- **Principal Investigator:** Serafim Rodrigues



## 4.1.3.

### BASQUE COUNTRY

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#### 4.1.3.1. BERC PROGRAM 2018-2021



- **Duration:** 01/01/2018 - 31/12/2021
- **Funded by:** Basque Government
- **Principal Investigator:** Jose Antonio Lozano
- **Funding:** 4,780,204€

#### 4.1.3.2. ELKARTEK



- **Project:** KK-2019/00015 bmG19 Biomarkers for early diagnosis and treatment monitoring in pulmonary hypertension
  - **Funding:** 66.159,15€
  - **Duration:** 01/03/2019 - 30/06/2021
  - **Principal Investigator:** Marco Ellero
- 
- **Project:** KK-2019/00035 AUTOLIB 2.0 Technological preparation for multivehicular automation for the industrial sector
  - **Funding:** 88.105,88€
  - **Duration:** 01/03/2019 - 31/03/2021
  - **Principal Investigator:** Santiago Mazuelas
- 
- **Project:** KK-2019/00072 SENDAI Integral Security for Industrial Intelligence
  - **Funding:** 89,037.08€
  - **Duration:** 01/06/2019 - 31/03/2021
  - **Principal Investigator:** Ekhine Irurozki
- 
- **Project:** KK-2019/00085 MATHEO Smart Mathematics for Offshore Wind Energy
  - **Funding:** 95.611,47€
  - **Duration:** 01/03/2019 - 31/12/2020
  - **Principal Investigator:** Marco Ellero

- **Project:** KK-2019/00095 DIGITAL Base technologies for industrial digitization
- **Funding:** 68.837,65€
- **Duration:** 01/03/2019 - 31/12/2020
- **Principal Investigator:** Aritz Pérez

- **Project:** KK-2019/00100 ALGORITMO Location Algorithms for Optimized Management of Smart Grids through Operational Monitoring Technologies
- **Funding:** 69.302,50€
- **Duration:** 01/03/2019 - 31/03/2021
- **Principal Investigator:** Aritz Pérez

- **Project:** KK-2020/00008 bG20 Precise medicine in cancer: Development of diagnostic tools and new therapies
- **Funding:** 94.184,94€
- **Duration:** 01/03/2020 - 31/12/2021
- **Principal Investigator:** Elena Akhmatskaya

- **Project:** KK-2020/00016 CIRCULO - Circular economy of metal resources (application to aluminium alloys)
- **Funding:** 95.503,67€
- **Duration:** 01/03/2020 - 31/12/2021
- **Principal Investigator:** Marco Ellero

- **Project:** KK-2020/00031 5G4BRIS3 - 5G for Basque RIS3
- **Funding:** 29.398,80€
- **Duration:** 01/03/2020 - 31/03/2021
- **Principal Investigator:** Santiago Mazuelas

- **Project:** KK-2020/00049 3KIA Integral and Transversal Proposal for the Design and Implementation of Reliable Systems based on Artificial Intelligence
- **Funding:** 134.132,28€
- **Duration:** 01/03/2020 - 31/12/2021
- **Principal Investigator:** María Xosé Rodríguez

- **Project:** KK-2020/00050 TWIN - NET Digital twin of the electricity distribution network to maximise renewable energy integration
- **Funding:** 102.690,00€
- **Duration:** 01/03/2020 - 31/12/2021
- **Principal Investigator:** Santiago Mazuelas

- **Project:** KK-2020/00054 TRUSTIND Creating Trust in the Industrial Digital Transformation
- **Funding:** 101.286,50€
- **Duration:** 01/03/2020 - 31/12/2021
- **Principal Investigator:** Jairo Rojas-Delgado

- **Project:** KK-2020/00102 COPTER Metrology applicable to highly complex geometries for ultra-precision transmissions
- **Funding:** 70.217,00€
- **Duration:** 01/03/2020 - 31/12/2021
- **Principal Investigator:** Michael Bartoň

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#### 4.1.3.3. SCIENTIFIC EQUIPMENT



- **Call:** Government - scientific equipment 2018
- **Project:** EC19-09 MCUBE
- **Funding:** 40.240,64€
- **Duration:** 15/09/2018 - 15/03/2020
- **Principal Investigator:** Serafim Rodrigues

## 4.2.

### PRIVATE FUNDING

#### AXA RESEARCH FUND



Research Fund

- **Call:** Mitigating risk in the wake of the COVID-19 pandemic
- **Project:** Early Prognosis of COVID-19 Infections via Machine Learning
- **Funding:** 230.000€
- **Duration:** 01/10/2020 - 30/09/2023
- **Principal Investigator:** Santiago Mazuelas

#### IBERDROLA FOUNDATION



- **Call:** Research Grants in Energy and Environment 2020
- **Project:** VIVIR - Validation of a method to reduce the Uncertainty of the Remaining Life of mooring systems for floating offshore wind turbines
- **Funding:** 19.997,00€
- **Duration:** 01/09/2020 - 31/08/2021
- **Principal Investigator:** Vincenzo Nava

- **Call:** Research Grants in Energy and Environment 2019
- **Project:** Artificial intelligence for demand management in environments with high penetration of renewable energies and electric vehicles
- **Funding:** 20.000,00€
- **Duration:** 01/09/2019 - 31/08/2020
- **Principal Investigator:** Santiago Mazuelas

#### BBVA FOUNDATION



- **Call:** Leonardo Grants for Researchers and Cultural Creators 2018
- **Project:** Data processing for decision making and open machine learning
- **Funding:** 40.000,00€
- **Duration:** 15/09/2018 - 15/03/2020
- **Principal Investigator:** Santiago Mazuelas

## 4.

Additionally, through the BCAM Knowledge Transfer Unit, the economic income of the center related to industrial projects with companies amounts to 110.112€.

## 4.2.1.

### PRIVATE INDIVIDUAL GRANTS

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#### 4.2.1.1. LA CAIXA

##### PREDOCTORAL GRANTS AND INPHINIT PROGRAM



- **Call:** La Caixa Severo Ochoa 2016
- **Beneficiaries:** Ezhilmathi Krishnasamy, Andrea Truccia, Havva Yoldas
- **Funding:** 321.300€

- **Call:** La Caixa Severo Ochoa 2017
- **Beneficiary:** Giulio Bonifazi
- **Funding:** 321.300€

- **Call:** INPhINIT 2020
- **Beneficiary:** Lorenzo Nagar
- **Funding:** 305.500€

#### 4.2.1.2. LA CAIXA

##### JUNIOR LEADER PROGRAMME

- **Call:** Junior Leader Fellowship 2018
- **Beneficiary:** Maurizio de Pitta
- **Funding:** 298.500€

- **Call:** Junior Leadership 2020
- **Beneficiary:** Florencio Balboa Usabiaga
- **Funding:** 297.900€

## 4.3.

### INDIVIDUAL GRANTS

#### 4.3.1.

EUROPEAN COMMISSION – HORIZON 2020 – EXCELLENCE PILLAR

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INDIVIDUAL FELLOWSHIPS – EUROPEAN FELLOWSHIPS (IF-SF):



- **Call:** H2020-MSCA-IF-2018
- **Project:** 832332-MinSOL-PDEs (H2020)  
Minimal solutions to nonlinear systems of PDEs
- **Funding:** 160.932,48€
- **Duration:** 01/12/2019 - 01/14/2022
- **Marie Curie Fellow:** Panayotis Smyrnelis
- **Advisor:** Arghir Dani Zarnescu

INDIVIDUAL FELLOWSHIPS – GLOBAL FELLOWSHIPS (IFGF):

- **Call:** H2020-MSCA-IF-GF 2020
- **Project:** 842536 - AEROSIMULAT (H2020)  
High-performance aerodynamics and aeroacoustics simulations of the new generation of high-speed gas turbines via high-order Galerking methods
- **Funding:** 245.732,16€
- **Duration:** 01/09/2020 - 31/08/2023
- **Marie Curie Fellow:** Margarida Moragues
- **Advisors:** Spencer Sherwin, Simone Marras



## 4.3.2.

### SPANISH STATE RESEARCH AGENCY

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#### 4.3.2.1. PREDOCTORAL GRANTS



- **Call:** PREDOC 2016
  - **Beneficiaries:** Iker Beñaran, Amaia Abanda, Irma Pallarés
  - **Funding:** 274.200€
- 
- **Call:** PREDOC 2017
  - **Beneficiaries:** Diana Marcela Pérez, Razvan-Dumitru Ceuca
  - **Funding:** 182.800€
- 
- **Call:** PREDOC 2018
  - **Beneficiaries:** Lore Zumeta, Marcus Dahlenburg, Marina Echeverria, Felipe Vinicio Caro, Oscar Alberto Rodríguez
  - **Funding:** 455.000€
- 
- **Call:** PREDOC 2019
  - **Beneficiaries:** Carlos Uriarte, Javier de la Bodega, Manuel Cañizares, Vizda Anam, Guillaume Girier, Miguel Camarasa, Maria Alejandra Hernández, Etor Arza
  - **Funding:** 763.600€

#### 4.3.2.2. RAMON Y CAJAL GRANTS



- **Call:** RYC 2016
- **Beneficiary:** Santiago Mazuelas
- **Funding:** 208.600€

- **Call:** RYC 2017
- **Beneficiary:** Michael Bartoň
- **Funding:** 308.600€

- **Call:** RYC 2018
- **Beneficiary:** Luz Roncal
- **Funding:** 308.600€

#### 4.3.2.3. JUAN DE LA CIERVA GRANTS



- **Call:** IJCI 2018 Incorporación
- **Beneficiary:** Mauricio Rincón
- **Funding:** 87.000€

- **Call:** IJCI 2019 Incorporación
- **Beneficiary:** Tomasz Szarek, Mateu Sousa
- **Funding:** 186.000€

- **Call:** FJCI 2019 Formación
- **Beneficiaries:** María A. García, Felipe Ponce
- **Funding:** 100.000€

## 4.3.3.

### BASQUE GOVERNMENT

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#### 4.3.3.1. PREDOCTORAL GRANTS



- **Call:** PREDOC 2017
- **Beneficiary:** Javier Canto
- **Funding:** 82.123,20€

- **Call:** PREDOC 2019
- **Beneficiary:** Onintze Zaballa
- **Funding:** 82.123,20€

#### 4.3.3.2. POST-DOCTORAL GRANTS

- **Call:** POSTDOC 2017
- **Beneficiary:** Julen Álvarez
- **Funding:** 110.964€

- **Call:** POSTDOC 2018
- **Beneficiary:** Judit Muñoz
- **Funding:** 91.453€

#### 4.3.3.3. UPV/EHU – INDUSTRIAL PHD STUDENT 2020 CALL



- **Call:** Grants for research staff training with institutions and companies 2020
- **Beneficiary:** Verónica Álvarez
- **Funding:** 18.750€

# 4.4.

## FUNDING INSTITUTIONS

### Distinctions



### Public funding institutions







**5.**

BCAM offers a wide range of scientific activities aiming to promote training, knowledge exchange and attraction and retention of research talent.

## 5.1.

### BCAM COURSES

In 2020 the number of BCAM courses was reduced due to the situation generated by the COVID-19 pandemic, but the center has managed to adapt to the new situation and has organized a total of 5 courses on diverse topics such as machine learning, Quasi Monte Carlo methods, Bayesian nonparametric methods.... These courses are oriented to the training of PhD students and research staff of BCAM and collaborators.

#### **Connecting solutions in second order phase transition models**

January 27, 2020 - January 31, 2020 - BCAM

*Dr. Panayotis Smyrnelis (BCAM)*

#### **An Introduction to Bayesian Nonparametric Methods**

February 05, 2020 - February 06, 2020 - BCAM

*Vanda Inácio de Carvalho (School of Mathematics, University of Edinburgh, UK)*

#### **An introduction to Randomized Quasi-Monte Carlo Methods and its Applications**

March 02, 2020 - March 06, 2020 - BCAM

*Florian Puchhammer (BCAM)*

#### **A Short Introduction to Pseudo-Spectral Methods – Part 1**

November 09, 2020 - November 13, 2020 at 09:00 - BCAM & UPV/EHU

*Sandeep Kumar (BCAM)*

#### **Decisions, data and machine learning**

November 16, 2020 - November 20, 2020 - BCAM & UPV/EHU

*Dr. Santiago Mazuelas (BCAM)*

## 5.2.

### COLLOQUIUMS IN MATHEMATICS AND ITS APPLICATIONS

Aiming to strengthen cooperation with other institutions, BCAM has reinforced its program of joint Colloquiums, not only with the University of the Basque Country, but also with collaborators, such as University of La Rioja or BGSMath.

#### **III Mathematical Analysis Days BCAM-UR in Logroño**

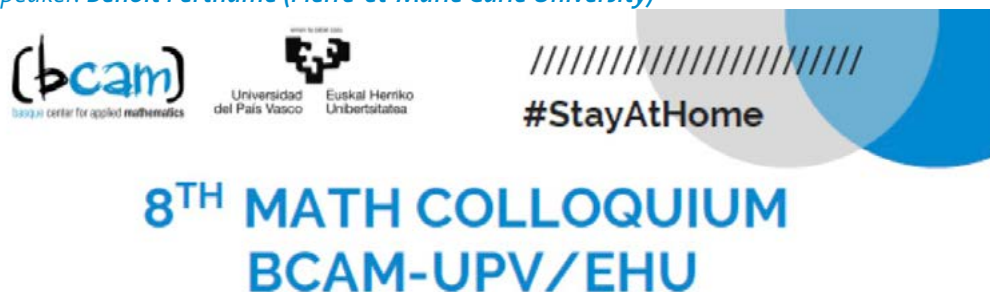
February 20, 2020

*Speakers: Luciano Abadías, José Luis Ansorena, Ioannis Parissis, Javier Martínez Perales, Rafael Granero-Belinchón, Judit Mínguez, Diana Stan, Daniel Eceizabarrena and Javier Duoandikoetxea (Unizar, UR, BCAM, UPV/EHU and UCantabria)*

#### **Eighth Math Colloquium BCAM - UPV/EHU**

May 06, 2020

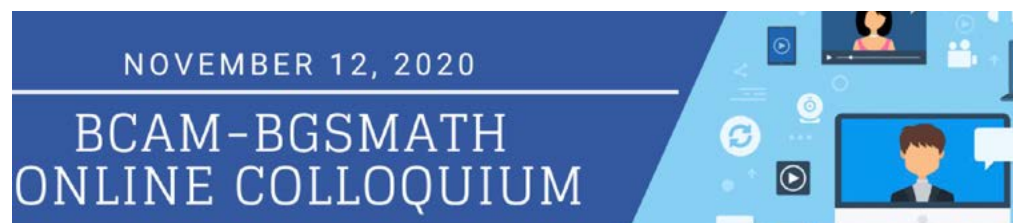
*Speaker: Benoît Perthame (Pierre-et-Marie Curie University)*



#### **BCAM – BGSMath online colloquium**

November 12, 2020

*Speakers: Jose Antonio Lozano, Gábor Lugosi (BCAM, UPF)*



#### **Ninth Math Colloquium BCAM - UPV/EHU**

December 02, 2020

*Speaker: Vicente Muñoz (Universidad de Málaga)*



# 5.3.

## SEMINARS

BCAM seminars program is aimed at training BCAM's scientific staff, exchange knowledge with the academic, industrial and business scientific community and to disseminate the very diverse applicability of mathematics.

This seminars program includes three categories:

- 5.3.1. Light PhD seminars:** This seminar series is organized by BCAM PhD students to promote a knowledge exchange space adapted to their needs. This space is dedicated to help PhD students improve their communication skills, especially their public presentations, in preparation for the defense of their thesis.
- 5.3.2. Scientific seminars:** In this series, BCAM collaborating researchers of reputed experience in their field and BCAM members offer talks in a wide range of topics.
- 5.3.3. Knowledge Transfer seminars:** As part of the BCAM Knowledge Transfer Unit activities, seminars involving industrial partners and associations are organized to put in evidence the various applications of Mathematics.

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### 5.3.1. Light PhD seminar series



**Light PhD Seminar: Mimicking heterogeneous diffusion with time dependent random diffusivity**

January 23, 2020

*Speaker: Vittoria Sposini (Institute for Physics & Astronomy, University of Potsdam)*

**Light PhD Seminar: Diagonalization of Shift-Preserving Operators**

February 10, 2020

*Speaker: Diana Carbajal (Universidad de Buenos Aires)*

**Light PhD Seminar: Profinite groups and the probability for two random integers to be coprime**

March 10, 2020

*Speaker: Iker de las Heras (UPV/EHU)*

**Light PhD Seminar: High Performance Scientific Computing and CFD Applications using Direct Finite Element Simulation**

July 09, 2020

*Speaker: Ezhilmathi Krishnasamy (BCAM)*

## 5.3.2. Scientific seminar series

### **BCAM Scientific Seminar: A novel two-stage approach for joint models of longitudinal and survival data**

January 13, 2020

*Speaker: Danilo Alvares (Pontificia Universidad Católica de Chile (Chile))*

### **BCAM Scientific Seminar: Non-deterministic algorithms and reinforcement learning**

February 18, 2020

*Speaker: Albert Garreta (UPV/EHU)*

### **BCAM Scientific Seminar: Application of Optimal Transport Theory to Fair Learning**

February 27, 2020

*Speaker: Paula Gordaliza (Institut de Mathématiques de Toulouse and IMUVA, Universidad de Valladolid)*

## 5.3.3. Knowledge Transfer seminar series

### **Knowledge Transfer Seminar: EU-MATHS-IN: mathematics for industry in Europe**

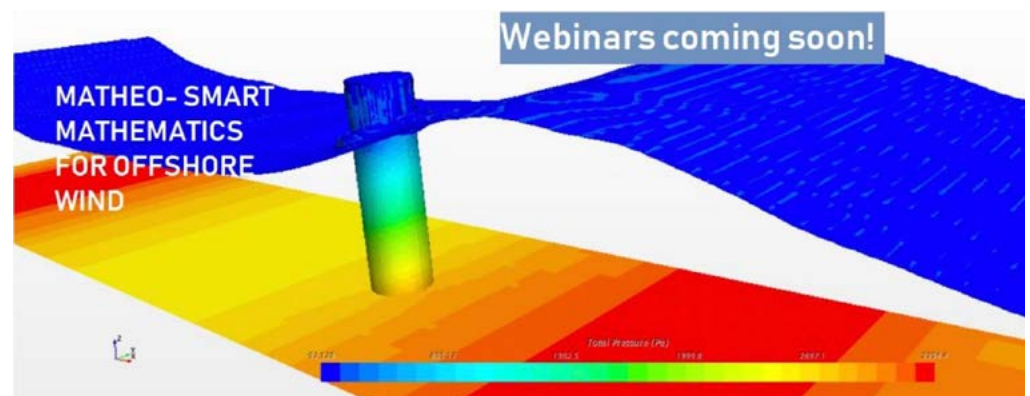
February 11, 2020

*Speaker: Wil Schilders (EU-MATHS-IN President)*

### **Webinars: MATHEO - Smart Mathematics for Offshore Wind**

October 30, 2020

*Speaker: David Pardo, Marco Ellero, Vincenzo Nava (BCAM)*



# 5.4.

## WORKSHOPS

Aimed at complementary training and the establishment of the state of the art in specific areas of mathematical research and the establishment and development of new dynamics of collaboration and research with companies and industries that want to apply the mathematical models that BCAM can develop.

### **5th EACA International School on Computer Algebra and its Applications**

February 25, 2020

*Speakers: Willem A. De Graaf, Irene Márquez Corbella, Gonzalo G. de Polavieja and Fernando Martín Maroto*

### **MATHROCKS - Simulations and Inversion Methods in Geophysics**

November 05, 2020

*Speakers: Monterrubio-Velasco, Carlos Torres-Verdín, Victor Martins-Gomez, Otilio Rojas, Mahdi Abedi, Jean Claude Puech, Victor M. Calo, Arijit Hazra, Sergio Rojas, Juan Carlos Galvis, -gnacio Muga, Ygee Larion, Mariano Fernández, Rose-Cloe Meyer*

*(Barcelona Supercomputing Center, The University of Texas at Austin, USA, University of Pau, France, Universidad Central de Venezuela, BCAM, RTS, France, Curtin University, Australia, BCAM, Curtin University, Australia, Universidad Nacional de Colombia, Pontificia Universidad Católica de Valparaíso, Chile, Université Libre de Bruxelles, Belgium, Universidad Politécnica de Cataluña, Spain, Inria, France)*

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**SIMULATION AND INVERSION METHODS IN GEOPHYSICS**

**Main Organizers:**  
Julien Díaz (Inria, UPPA, France)  
David Pardo (UPV/EHU, BCAM, Spain)

**Scientific Committee:**  
Helene Barucq (Inria, UPPA, France)  
David Pardo (UPV/EHU, BCAM, Spain)  
Josep de la Puente (BSC, Spain)  
Pedro Díez (UPC, Spain)  
Julien Díaz (Inria, UPPA, France)

**5 Nov. 2020, 1pm-5pm**  
**6 Nov. 2020, 1pm-5pm**

**MATHROCKS Website**  
**Online Meeting Link**

# 5.5.

## WORKING GROUPS

Internal working group sessions, oriented to the training of BCAM, postdoctoral fellows and PhD students. In fact, during 2020, the following BCAM working seminars in APDE have been carried out:

- **Recent advances in discrete NLS-type equations and their continuum limit**  
January 09, 2020  
*Author: Ricardo Grande Izquierdo (Massachusetts Institute of Technology, USA)*
- **An analytic-algebraic approach to linear response theory**  
January 16, 2020  
*Author: Giuseppe De Nittis (Pontificia Universidad Católica de Chile, Chile)*
- **Construction of group invariant spaces for approximating functional data, with applications to digital images**  
September 10, 2020  
*Author: Davide Barbieri (Universidad Autónoma de Madrid)*
- **On some properties for an incompressible, non-viscous in-out flow in a 2D domain**  
September 17, 2020  
*Author: Marco Bravin (BCAM)*
- **On the Boundary Harnack Principle**  
October 22, 2020  
*Speaker: Daniela De Silva (Barnard College - Columbia University)*
- **Fourier interpolation with the zeros of the Riemann zeta function**  
October 29, 2020  
*Speaker: Kristian Seip (NTNU)*
- **Connections between Bombieri-type inequalities and equidistribution of points on Riemannian manifolds**  
November 05, 2020  
*Speaker: Ujué Etayo (TU Graz)*

- **Connections between Bombieri-type inequalities and equidistribution of points on Riemannian manifolds**  
November 06, 2020  
*Speaker: Ujué Etayo (TU Graz)*
- **Approximation and Coincidence: Corona Decompositions vs. Big Pieces**  
November 12, 2020  
*Speaker: Simon Bortz (University of Alabama)*
- **Construction of quasimodes for non-selfadjoint operators using propagation of wave-packets**  
November 19, 2020  
*Speaker: Victor Arnaiz (Laboratoire de Mathématiques d'Orsay)*
- **Vector-valued extensions of multilinear operators and a multilinear UMD condition**  
November 26, 2020  
*Speaker: Zoe Nieraeth (BCAM)*
- **Sharp estimates in certain theorems of Marcinkiewicz, Sjögren and Sjölin**  
December 03, 2020  
*Speaker: Odysseas Bakas (Lund University)*
- **Sharp constants for maximal operators on finite graphs**  
December 10, 2020  
*Speaker: Cristian González-Riquelme (IMPA)*
- **About Schrödinger and Dirac operators with scaling critical potentials**  
December 17, 2020  
*Speaker: Luca Fanelli (Ikerbasque and UPV/EHU)*

## 5.6.

### PARTICIPATION IN INTERNATIONAL CONGRESSES AND VISITS TO OTHER RESEARCH CENTERS

As part of the research activities, BCAM researchers participate in congresses, workshops and working meetings. This is an important element in the dissemination of the center's activities, and in its consolidation as a center of international reference. We must point out that due to the COVID-19 outbreak, in 2020 a lot of congresses have been cancelled or postponed to 2021.

#### **January 2020**

V Congress of Young Researchers of the RSME

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5th Annual Meeting of the RGAS network

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Statistical tools for plant phenomic data analysis

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Workshop on PDEs: Modelling, Analysis and Numerical Simulation

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Workshop on singularities in variational models

#### **February 2020**

IMI 2 Joint Undertaking (IMI 2 JU)

---

Mathematics of Complex Systems in Biology and Medicine

---

III Mathematical Analysis Days BCAM-UR in Logroño

---

11th Conference on dynamical systems applied to biology and natural sciences

---

158th European Study Group with Industry (ESGI)

#### **June 2020**

ECAI 2020

---

EAGE 2020

---

Symposium on Solid and Physical Modeling (SPM) 2020

## **July 2020**

CNS 2020

---

Glia in Health & Disease 2020

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FENS Forum 2020

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GECCO 2020

## **August 2020**

PGM 2020

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StanCon 2020

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ECML-PKDD 2020

## **October 2020**

I Virtual Congress of the Spanish Society of Epidemiology (SEE), and of the Portuguese Epidemiology Association (APE)

## **November 2020**

NeurIPS 2020

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Annual Meeting of the APS Division of Fluid Dynamics

---

XXXIII International Seminar on Statistics: Mechanistic and statistical models for epidemic outbreaks: The case of COVID-19 in the Basque Country

## **December 2020**

International Conference on the ERCIM WG on Computational and Methodological Statistics (CMStatistics 2020)

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International Congress in Rheology

Finally, due to COVID-19 the following events were postponed to 2021:

- **SIAM conference on Mathematical Aspects of Material Science**



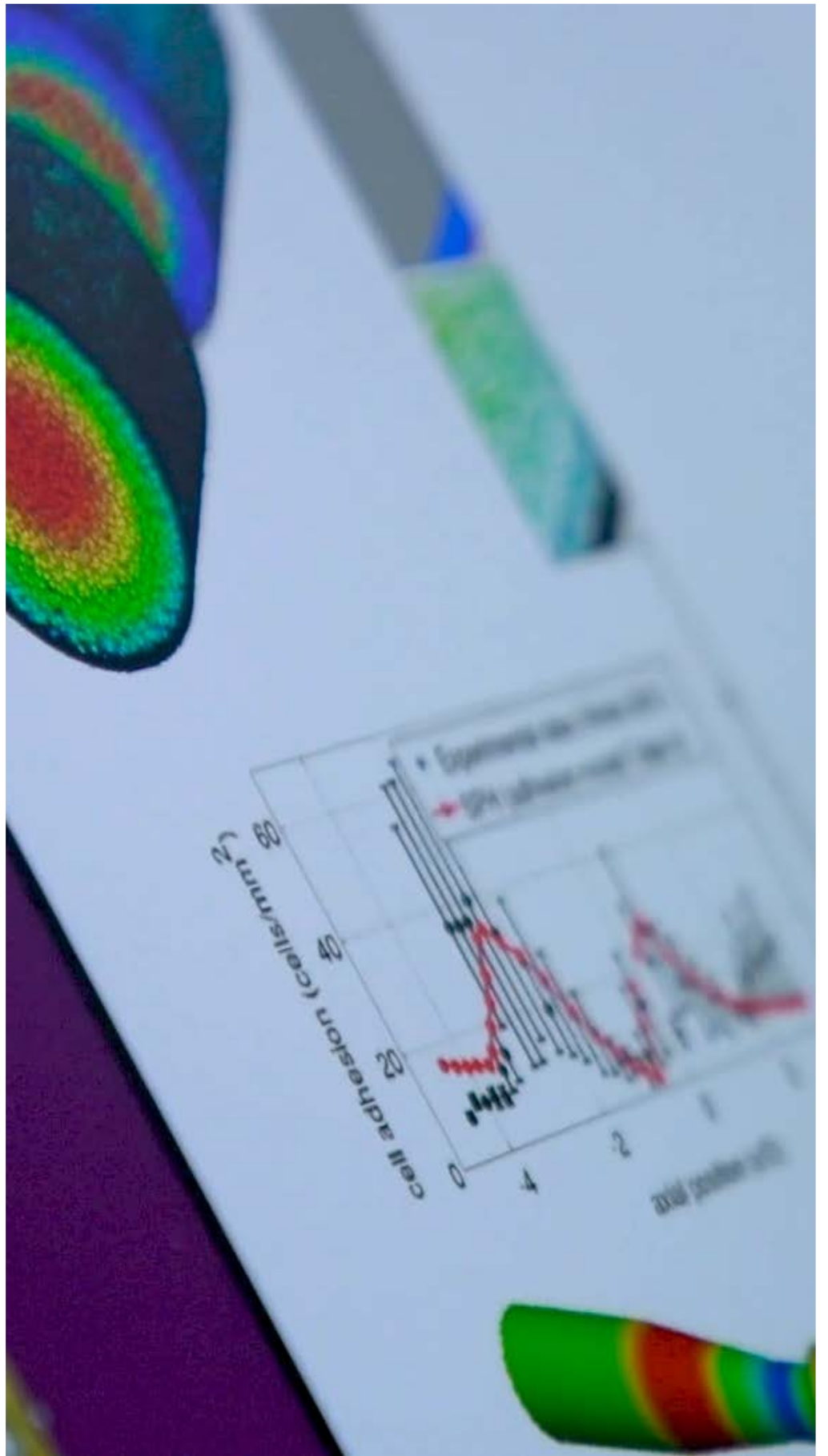
- **ECML PKDD 2020**



- **IWSM 2020: 35th international workshop on statistical modelling**









PUBLICATIONS

$\gamma = 2\gamma$

and  $D_0$  is a microscopic distance  
to  $2\gamma$  to separate the two phases

surface energy is to consider that  
subjected to a specific environment  
om molecules "buried" in the bulk of  
is thus naturally introduced, attached  
y is thus naturally introduced, attached  
ules at the interface, which are exposed  
energy obviously depends on the nature of  
interface. The higher the cohesion of the  
e surface, the higher the surface energy of the formed  
development is contained within the Hamaker constant  
pression, obtained in the specific case presented by the  
preceding chapter [5]. To cite an example, metals, polymers  
(resembling covalent bonds), whose internal cohesion is  
Waals forces (e.g. teflon, plastic), whose internal cohesion is  
n der Waals forces (much weaker than covalent bonds), and  
weak energies. The surface energy for a metal/air interface is  
the order of  $20 \text{ mJ/m}^2$ .  
All these conclusions assume that we are working at scales much  
the range of intermolecular forces appearing at interfaces. As we  
in Chapter 1, this hypothesis is well verified in ordinary microfluidics  
However, this hypothesis must be reconsidered for canals of size  
100 nm.

### Laplace's Law

Laplace's Law demonstrates that in order to maintain a curved interface  
in equilibrium, it is necessary to exert a higher pressure in the  
interior.

**Figure 2.20** Geometry used for the derivation of the Laplace's Law

rather as if it had to be maintained by blowing. We consider a cylinder of radius  $R$  that forms an interface between two media (Fig. 2.20). This interface is associated with an energy:

$$E_s = 2\gamma \pi R L,$$

where  $\gamma$  is the surface tension. We assume that the interior of the cylinder is at a pressure  $P$ , and the exterior is in a vacuum (at zero pressure). The internal energy required to maintain such a pressure is written:

$$E_p = \pi R^2 L P.$$

We look to find the mechanical equilibrium conditions of the cylinder at equilibrium, the corresponding energy variation is:

$$\delta E_s = \delta E_p.$$

This implies

which is Laplace's Law for a cylindrical interface. In order to maintain a curved interface in equilibrium, it is necessary to introduce a higher pressure in the interior as  $R_1$  and  $R_2$ . We thus obtain:

### 2.7.4 Wettability

Wetting  
(Fig. 2.21)  
an interface  
the contact angle

	<b>AUTHORS</b>	<b>TITLE</b>
<b>01</b>	Zaballa O., Pérez A., Inhiesto E.G., Ayesta T.A., Lozano J.A.	Identifying common treatments from Electronic Health Records with missing information. An application to breast cancer
<b>02</b>	Fülöp T., Desroches M., A Cohen A., Santos F.A.N., Rodrigues S.	Why we should use topological data analysis in ageing: Towards defining the “topological shape of ageing”
<b>03</b>	Aguiar M., Stollenwerk N.	The impact of serotype cross-protection on vaccine trials: Denvax as a case study
<b>04</b>	Aguiar M., Ortuondo E.M., Bidaurrazaga Van-Dierdonck J., Mar J., Stollenwerk N.	Modelling COVID 19 in the Basque Country from introduction to control measure response
<b>05</b>	Andjelković M., Tadić B., Melnik R.	The topology of higher-order complexes associated with brain hubs in human connectomes
<b>06</b>	Radivojević T., Costello Z., Workman K., Garcia Martin H.	A machine learning Automated Recommendation Tool for synthetic biology
<b>07</b>	Zhang J., Petersen S.D., Radivojevic T., Ramirez A., Pérez-Manríquez A., Abeliuk E., Sánchez B.J., Costello Z., Chen Y., Fero M.J., Martin H.G., Nielsen J., Keasling J.D., Jensen M.K.	Combining mechanistic and machine learning models for predictive engineering and optimization of tryptophan metabolism
<b>08</b>	Albizuri J.U., Desroches M., Krupa M., Rodrigues S.	Inflection, Canards and Folded Singularities in Excitable Systems: Application to a 3D FitzHugh–Nagumo Model
<b>09</b>	Di Plinio F., Li K., Martikainen H., Vuorinen E.	Multilinear singular integrals on non-commutative $L_p$ spaces
<b>10</b>	Cayama J., Cuesta C.M., de la Hoz F.	Numerical approximation of the fractional Laplacian on $\mathbb{R}$ using orthogonal families

SOURCE TITLE	VOLUME	ISSUE	PAGE START	PAGE END	DOI	DOCUMENT TYPE
PLoS ONE	15	12 December			10.1371/ journal. pone.0244004	Article
Mechanisms of Ageing and Development	192				10.1016/j.mad. 2020.111390	Article
Vaccines	8	4	1	12	10.3390/ vaccines8040674	Article
Scientific Reports	10	1			10.1038/s41598 -020-74386-1	Article
Scientific Reports	10	1			10.1038/s41598 -020-74392-3	Article
Nature Com- munications	11	1			10.1038/s41467 -020-18008-4	Article
Nature Com- munications	11	1			10.1038/s41467 -020-17910-1	Article
Journal of Nonlinear Science	30	6	3265	3291	10.1007/s00332 -020-09650-9	Article
Mathematis- che Annalen	378	3-abr	1371	1414	10.1007/s00208 -020-02068-4	Article
Applied Numerical Mathematics	158		164	193	10.1016/j.apnum. 2020.07.024	Article

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<b>11</b>	Arza E., Pérez A., Irurozki E., Ceberio J.	Kernels of Mallows Models under the Hamming Distance for solving the Quadratic Assignment Problem
<b>12</b>	He X., Du H., Tong Z., Wang D., Wang L., Melnik R.	A dynamic hysteresis model based on Landau phenomenological theory of fatigue phenomenon in ferroelectrics
<b>13</b>	Ircio J., Lojo A., Mori U., Lozano J.A.	Mutual information based feature subset selection in multivariate time series classification
<b>14</b>	Marino E., Hosseini S.F., Hashemian A., Reali A.	Effects of parameterization and knot placement techniques on primal and mixed isogeometric collocation formulations of spatial shear-deformable beams with varying curvature and torsion
<b>15</b>	Granero-Belinchón R., Scrobogna S.	Well-posedness of water wave model with viscous effects
<b>16</b>	Beltran D., Vega L.	Bilinear identities involving the k-plane transform and Fourier extension operators
<b>17</b>	Abedi M.M., Stovas A.	A new acoustic assumption for orthorhombic media
<b>18</b>	Skopenkov M., Bo P., Bartoň M., Pottmann H.	Characterizing envelopes of moving rotational cones and applications in CNC machining

SOURCE TITLE	VOLUME	ISSUE	PAGE START	PAGE END	DOI	DOCUMENT TYPE
Swarm and Evolutionary Computation	59				10.1016/j.swevo.2020.100740	Article
Materials Today Communications	25				10.1016/j.mtcomm.2020.101479	Article
Pattern Recognition	108				10.1016/j.patcog.2020.107525	Article
Computers and Mathematics with Applications	80	11	2563	2585	10.1016/j.camwa.2020.06.006	Article
Proceedings of the American Mathematical Society	148	12	5181	5191	10.1090/proc/15219	Article
Proceedings of the Royal Society of Edinburgh Section A: Mathematics	150	6	3349	3377	10.1017/prm.2019.74	Article
Geophysical Journal International	223	2	1118	1129	10.1093/gji/ggaa367	Article
Computer Aided Geometric Design	83				10.1016/j.cagd.2020.101944	Article

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19	Deng Y., Zillinger C.	On the smallness condition in linear inviscid damping: monotonicity and resonance chains
20	Aguiar M., Stollenwerk N.	Condition-specific mortality risk can explain differences in COVID-19 case fatality ratios around the globe
21	Garcia-Sanchez D., Fernandez-Navamuel A., Sánchez D.Z., Alvear D., Pardo D.	Bearing assessment tool for longitudinal bridge performance
22	Ebrahimi-Fizik A., Lakzian E., Hashemian A.	Numerical investigation of wet inflow in steam turbine cascades using NURBS-based mesh generation method
23	Di Plinio F., Li K., Martikainen H., Vuorinen E.	Multilinear operator-valued Calderón-Zygmund theory
24	Fernández E., Roncal L.	A Decomposition of Calderón–Zygmund Type and Some Observations on Differentiation of Integrals on the Infinite-Dimensional Torus
25	Li K., Martell J.M., Ombrosi S.	Extrapolation for multilinear Muckenhoupt classes and applications
26	Kaupuzs J., Melnik R.V.N.	A new method of solution of the Wetterich equation and its applications
27	Sala C., Giampieri E., Vitali S., Garagnani P., Remondini D., Bazzani A., Franceschi C., Castellani G.C.	Gut microbiota ecology: Biodiversity estimated from hybrid neutral-niche model increases with health status and aging



SOURCE TITLE	VOLUME	ISSUE	PAGE START	PAGE END	DOI	DOCUMENT TYPE
Nonlinearity	33	11	6176	6194	10.1088/1361-6544/aba236	Article
Public Health	188		18	20	10.1016/j.puhe.2020.08.021	Article
Journal of Civil Structural Health Monitoring	10	5	1023	1036	10.1007/s13349-020-00432-1	Article
International Communications in Heat and Mass Transfer	118	8			10.1016/j.icheatmasstransfer.2020.104812	Article
Journal of Functional Analysis	279	4	1449		10.1016/j.jfa.2020.108666	Article
Potential Analysis	53			1465	10.1007/s11118-019-09813-8	Article
Advances in Mathematics	373				10.1016/j.aim.2020.107286	Article
Journal of Physics A: Mathematical and Theoretical	53	41			10.1088/1751-8121/abac96	Article
PLoS ONE	15	10 October			10.1371/journal.pone.0237207	Article

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28	Tadić B., Melnik	Modeling latent infection transmissions through biosocial stochastic dynamics
29	Ruiz-minguela P., Nava V., Hodges J., Blanco J.M.	Review of systems engineering (Se) methods and their application to wave energy technology development
30	Badu S., Melnik R., Singh S.	Analysis of photosynthetic systems and their applications with mathematical and computational models
31	Carpio A., Iakunin S., Stadler G.	Bayesian approach to inverse scattering with topological priors
32	Caro P., Garcia A.	Scattering with Critically-Singular and $\delta$ -Shell Potentials
33	Sanchez-Magraner L., Miles J., Baker C.L., Applebee C.J., Lee D.-J., Elsheikh S., Lashin S., Withers K., Watts A.G., Parry R., Edmead C., Lopez J.I., Mehta R., Italiano A., Ward S.G., Parker P.J., Larijani B.	High PD-1/PD-L1 checkpoint interaction infers tumor selection and therapeutic sensitivity to anti-PD-1/PD-L1 treatment
34	Li X., Barton M., Nelaturi S.	SPM 2020 Editorial
35	Darrigrand V., Pardo D., Chaumont-Frelet T., Gómez-Revuelto I., Garcia-Castillo L.E.	A painless automatic hp-adaptive strategy for elliptic problems
36	Peñafort Sanchis G.	Reflection maps
37	Singh S., Krishnaswamy J.A., Melnik R.	Biological cells and coupled electro-mechanical effects: The role of organelles, microtubules, and nonlocal contributions

SOURCE TITLE	VOLUME	ISSUE	PAGE START	PAGE END	DOI	DOCUMENT TYPE
PLoS ONE	15	10			10.1371/journal.pone.0241163	Article
Journal of Marine Science and Engineering	8	10	1	25	10.3390/jmse8100823	Review
Applied Sciences (Switzerland)	10	19			10.3390/app10196821	Review
Inverse Problems	36	10			10.1088/1361-6420/abaa30	Article
Communications in Mathematical Physics	379	2	543	587	10.1007/s00220-020-03847-5	Article
Cancer Research	80	19	4244	4257	10.1158/0008-5472.CAN-20-1117	Article
CAD Computer Aided Design	127				10.1016/j.cad.2020.102909	Editorial
Finite Elements in Analysis and Design	178				10.1016/j.finel.2020.103424	Article
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Journal of the Mechanical Behavior of Biomedical Materials	110				10.1016/j.jmbm.2020.103859	Article

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38	Hashemian A., Bo P., Bartoň M.	Reparameterization of Ruled Surfaces: Toward Generating Smooth Jerk-minimized Toolpaths for Multi-axis Flank CNC Milling
39	Durante D., Rossi E., Colagrossi A.	Bifurcations and chaos transition of the flow over an airfoil at low Reynolds number varying the angle of attack
40	BADU S., PRABHAKAR S., MELNIK R.	Component spectroscopic properties of light-harvesting complexes with dft calculations
41	Badu S., Melnik R., Singh S.	Mathematical and computational models of RNA nanoclusters and their applications in data-driven environments
42	Nagy J., Némethi A.	The Abel map for surface singularities II. Generic analytic structure
43	Abedi M.M.	Rational approximation of P-wave kinematics - Part 1: Transversely isotropic media
44	Abedi M.M.	Rational approximation of P-wave kinematics - Part 2: Orthorhombic media
45	Piette J.H., Moreno N., Fried E., Giacomini A.J.	The complex viscosity of Möbius macromolecules
46	Marimon N., Eduardo I., Martínez-Minaya J., Vicent A., Luque J.	A decision support system based on degree-days to initiate fungicide spray programs for peach powdery mildew in Catalonia, Spain
47	Fanelli L., Krejčířik D., Laptev A., Vega L.	On the improvement of the Hardy inequality due to singular magnetic fields

SOURCE TITLE	VOLUME	ISSUE	PAGE START	PAGE END	DOI	DOCUMENT TYPE
CAD Computer Aided Design	127				10.1016/j.cad.2020.102868	Article
Communications in Non-linear Science and Numerical Simulation	89				10.1016/j.cnsns.2020.105285	Article
Biocell	44	3	279	291	10.32604/biocell.2020.010916	Article
Molecular Simulation	46	14	1094	1115	10.1080/08927022.2020.1804564	Article
Advances in Mathematics	371				10.1016/j.aim.2020.107268	Article
Geophysics	85	5	C163	C173	10.1190/geo2020-0005.1	Article
Geophysics	85	5	C175	C186	10.1190/geo2020-0006.1	Article
Physics of Fluids	32	9			10.1063/5.0022546	Article
Plant Disease	104	9	2418	2425	10.1094/PDIS-10-19-2130-RE	Article
Communications in Partial Differential Equations	45	9	1202	1212	10.1080/03605302.2020.1763399	Article

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49	Dan A., Kaur I.	Néron models of intermediate Jacobians associated to moduli spaces
50	Liu Y., Maxim L., Wang B.	Perverse sheaves on semi-abelian varieties—a survey of properties and applications
51	Budur N., Liu Y.	On the length of perverse sheaves on hyperplane arrangements
52	Mazuelas S., Pérez A.	General supervision via probabilistic transformations
53	Cendoya M., Martínez-Minaya J., Dalmau V., Ferrer A., Saponari M., Conesa D., López-Quílez A., Vicent A.	Spatial Bayesian Modeling Applied to the Surveys of <i>Xylella fastidiosa</i> in Alicante (Spain) and Apulia (Italy)
54	Kenig C.E., Pilod D., Ponce G., Vega L.	On the unique continuation of solutions to non-local non-linear dispersive equations
55	Górska K., Horzela A., Lenzi E.K., Pagnini G., Sandev T.	Generalized Cattaneo (telegrapher's) equations in modeling anomalous diffusion phenomena
56	Ponce-Vanegas F.	Reconstruction of the derivative of the conductivity at the boundary

SOURCE TITLE	VOLUME	ISSUE	PAGE START	PAGE END	DOI	DOCUMENT TYPE
Archive for Rational Mechanics and Analysis	237	3	1421	1473	10.1007/s00205-020-01539-x	Article
Revista Matematica Complutense	33	3	885	910	10.1007/s13163-019-00333-y	Article
European Journal of Mathematics	6	3	977	997	10.1007/s40879-019-00340-9	Article
European Journal of Mathematics	6	3	681	712	10.1007/s40879-019-00371-2	Article
Frontiers in Artificial Intelligence and Applications	325		1348	1354	10.3233/FAIA200238	Conference Paper
Frontiers in Plant Science	11				10.3389/fpls.2020.01204	Article
Communications in Partial Differential Equations	45	8	872	886	10.1080/03605302.2020.1739707	Article
Physical Review E	102	2			10.1103/PhysRevE.102.022128	Article
Inverse Problems and Imaging	14	4	701	718	10.3934/ipi.2020032	Article

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| 57 | Oregi I., Del Ser J., Pérez A., Lozano J.A.   | Robust image classification against adversarial attacks using elastic similarity measures between edge count sequences |
| 58 | Ciaurri Ó., Nowak A., Roncal L.   | Maximal estimates for a generalized spherical mean Radon transform acting on radial functions                          |
| 59 | Egorova V.N., Trucchia A., Pagnini G.   | Fire-spotting generated fires. Part I: The role of atmospheric stability   |
| 60 | Halstead S.B., Katzelnick L.C., Russell P.K., Markoff L., Aguiar M., Dans L.R., Dans A.L. | Ethics of a partially effective dengue vaccine: Lessons from the Philippines   |
| 61 | Arza E., Ceberio J., Pérez A., Irurozki E.  | An adaptive neuroevolution-based hyperheuristic  |
| 62 | Banica V., Vega L.  | On the energy of critical solutions of the binormal flow   |
| 63 | Higuera M., Howes A., López-Fidalgo J.  | Optimal experimental design for cytogenetic dose–response calibration curves   |
| 64 | Rakshit P., Konar A., Nagar A.K.  | Q-Learning Induced Artificial Bee Colony for Noisy Optimization  |



SOURCE TITLE	VOLUME	ISSUE	PAGE START	PAGE END	DOI	DOCUMENT TYPE
Neural Networks	128		61	72	10.1016/j.neu net.2020.04.030	Article
Annali di Matematica Pura ed Applicata	199	4	1597	1619	10.1007/s10231- 019-00933-x	Article
Applied Mathematical Modelling	84		590	609	10.1016/j.apm. 2019.02.010	Article
Vaccine	38	35	5572	5576	1016/j.vaccine. 2020.06.079	Note
GECCO 2020 Companion - Proceedings of the 2020 Genetic and Evolutionary Computation Conference Companion			111	112	10.1145/3377 929.3389937	Conference Paper
Communica- tions in Partial Differential Equations	45	7	820	845	10.1080/03605 302.2020.1738 460	Article
International Journal of Ra- diation Biology	96	7	894	902	10.1080/09553 002.2020.1741 719	Article
2020 IEEE Con- gress on Evolu- tionary Compu- tation, CEC 2020 - Conference Proceedings					10.1109/CEC48 606.2020.9185 844	Conference Paper

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- 65 Rakshit P., Chowdhury A., Konar A., Nagar A.K. Migration in Multi-Population Differential Evolution for Many Objective Optimization
- 66 Malagon M., Irurozki E., Ceberio J. Alternative Representations for Codifying Solutions in Permutation-Based Problems
- 67 Sebastiani L., Magrini M., Orsini P., Mastorci F., Pingitore A., Paradisi P. Pilot study on music-heart entrainment in a pianist during a live performance
- 68 Touzon I., Nava V., de Miguel B., Petuya V. A comparison of numerical approaches for the design of mooring systems for wave energy converters
- 69 Badu S., Prabhakar S., Melnik R. Coarse-grained models of RNA nanotubes for large time scale studies in biomedical applications
- 70 Bru J.-B., de Siqueira Pedra W. Macroscopic Dynamics of the Strong-Coupling BCS-Hubbard Model

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2020 IEEE Congress on Evolutionary Computation, CEC 2020 - Conference Proceedings					10.1109/CEC48606.2020.9185596	Conference Paper
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2020 IEEE Congress on Evolutionary Computation, CEC 2020 - Conference Proceedings					10.1109/CEC48606.2020.9185678	Conference Paper
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2020 11th Conference of the European Study Group on Cardiovascular Oscillations: Computation and Modelling in Physiology: New Challenges and Opportunities, ESGCO 2020					10.1109/ESG-CO49734.2020.9158149	Conference Paper
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Journal of Marine Science and Engineering	8	7			10.3390/JMSE8070523	Article
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Biomedicines	8	8			10.3390/BIOMEDICINES8070195	Article
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Physics of Particles and Nuclei	51	4	802	806	10.1134/S106377962004019X	Article
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71	Aguiar M., Van-Dierdonck J.B., Stollenwerk N.	Reproduction ratio and growth rates: Measures for an unfolding pandemic
72	Ombrosi S., Pérez C., Rela E., Rivera-Ríos I.P.	A note on generalized Fujii-Wilson conditions and BMO spaces
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74	Fülöp T., Munawara U., Larbi A., Desroches M., Rodrigues S., Catanzaro M., Guidolin A., Khalil A., Bernier F., Barron A.E., Hirokawa K., Beauregard P.B., Dumoulin D., Bellenger J.-P., Witkowski J.M., Frost E.	Targeting Infectious Agents as a Therapeutic Strategy in Alzheimer's Disease
75	Kumar S.S.P., Vázquez-Quesada A., Ellero M.	Numerical investigation of the rheological behavior of a dense particle suspension in a biviscous matrix using a lubrication dynamics method
76	Veligatla M., Garcia-Cervera C.J., Müllner P.	Magnetic domain-twin boundary interactions in Ni-Mn-Ga
77	Cejas M.E., Li K., Pérez C., Rivera-Ríos I.P.	Vector-valued operators, optimal weighted estimates and the Cp condition
78	Cesana P., Della Porta F., Rüländ A., Zillinger C., Zwicknagl B.	Exact Constructions in the (Non-linear) Planar Theory of Elasticity: From Elastic Crystals to Nematic Elastomers
79	Li K., Martikainen H., Vuorinen E.	Bloom Type Upper Bounds in the Product BMO Setting

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PLoS ONE	15	7 July			10.1371/journal.pone.0236620	Article
Israel Journal of Mathematics	238	2	571	591	10.1007/s11856-020-2031-y	Article
Proceedings of the London Mathematical Society	121	1	51	82	10.1112/plms.12310	Article
CNS Drugs	34	7	673	695	10.1007/s40263-020-00737-1	Article
Journal of Non-Newtonian Fluid Mechanics	281				10.1016/j.jnnfm.2020.104312	Article
Acta Materialia	193		221	228	10.1016/j.actamat.2020.03.045	Article
Science China Mathematics	63	7	1339	1368	10.1007/s11425-018-9404-4	Article
Archive for Rational Mechanics and Analysis	237	1	383	445	10.1007/s00205-020-01511-9	Article
Journal of Geometric Analysis	30	3	3181	3203	10.1007/s12220-019-00194-3	Article



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GECCO 2020 - Proceedings of the 2020 Genetic and Evolutionary Computation Conference			201	209	10.1145/33779 30.3390241	Conference Paper
BMC Evolutio- nary Biology	20	1			10.1186/s12862 -020- 01635-2	Article
Quarterly Journal of Mathematics	71	2	451	483	10.1093/qmath j/haz053	Article
Computer Methods in Biomechanics and Biomedical Engineering	23	8	396	407	10.1080/10255 842.2020. 1733 991	Article
Respiratory Research	21	1			10.1186/s1293 1-020-01395-z	Article
Journal of the American Chemical Society	142	22	9896	9901	10.1021/jacs.0c 02549	Article

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86	J.D.Eceizabarrena D.	Geometric differentiability of Riemann's non-differentiable function
87	Banica V., Vega L.	Evolution of Polygonal Lines by the Binormal Flow
88	Sposini V., Grebenkov D.S., Metzler R., Oshanin G., Seno F.	Universal spectral features of different classes of random-diffusivity processes
89	Singh S., Melnik R.	Domain heterogeneity in radiofrequency therapies for pain relief: A computational study with coupled models
90	Shahriari M., Pardo D., Picon A., Galdran A., Del Ser J., Torres-Verdín C.	A deep learning approach to the inversion of borehole resistivity measurements
91	Shahriari M., Pardo D.	Borehole resistivity simulations of oil-water transition zones with a 1.5D numerical solver
92	Birbrair L., Fernandes A., Sampaio J.E., Verbitsky M.	Multiplicity of singularities is not a bi-Lipschitz invariant
93	Barredo Arrieta A., Díaz-Rodríguez N., Del Ser J., Bennetot A., Tabik S., Barbado A., Garcia S., Gil-Lopez S., Molina D., Benjamins R., Chatila R., Herrera F.	Explainable Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI
94	Bartoň M., Puzyrev V., Deng Q., Calo V.	Efficient mass and stiffness matrix assembly via weighted Gaussian quadrature rules for B-splines
95	Li K., Martikainen H., Vuorinen E.	Bilinear Calderón–Zygmund theory on product spaces



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Advances in Mathematics	366				10.1016/j.aim.2020.107091	Article
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Bioengineering	7	2			10.3390/bioengineering7020035	Article
Computational Geosciences	24	3	971	994	10.1007/s10596-019-09859-y	Article
Computational Geosciences	24	3	1285	1299	10.1007/s10596-020-09946-5	Article
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Information Fusion	58		82	115	10.1016/j.inffus.2019.12.012	Article
Journal of Computational and Applied Mathematics	371				10.1016/j.cam.2019.112626	Article
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97	Taylor J.M.	$\Gamma$ -convergence of a mean-field model of a chiral doped nematic liquid crystal to the Oseen-Frank description of cholesterics
98	Cusimano N., Del Teso F., Gerardo-Giorda L.	Numerical approximations for fractional elliptic equations via the method of semigroups
99	Garra R., Falcini F., Voller V.R., Pagnini G.	A generalized Stefan model accounting for system memory and non-locality
100	Correia S., Côte R., Vega L.	Asymptotics in Fourier space of self-similar solutions to the modified Korteweg-de Vries equation
101	Capó M., Pérez A., Lozano J.A.	An efficient K-means clustering algorithm for tall data
102	Di Fratta G., Robbins J.M., Slastikov V., Zarnescu A.	Landau-de Gennes Corrections to the Oseen-Frank Theory of Nematic Liquid Crystals
103	Cusimano N., Gizzi A., Fenton F.H., Filippi S., Gerardo-Giorda L.	Key aspects for effective mathematical modelling of fractional-diffusion in cardiac electrophysiology: A quantitative study

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Artificial Intelligence Review	53	5	3575	3594	10.1007/s10462-019-09771-y	Article
Nonlinearity	33	6	3062	3102	10.1088/1361-6544/ab74f5	Article
ESAIM: Mathematical Modelling and Numerical Analysis	54	3	751	774	10.1051/m2an/2019076	Article
International Communications in Heat and Mass Transfer	114				10.1016/j.icheatmasstransfer.2020.104584	Article
Journal des Mathématiques Pures et Appliquées	137		101	142	10.1016/j.mtpur.2020.03.013	Article
Data Mining and Knowledge Discovery	34	3	776	811	10.1007/s10618-020-00678-9	Article
Archive for Rational Mechanics and Analysis	236	2	1089	1125	10.1007/s00205-019-01488-0	Article
Communications in Non-linear Science and Numerical Simulation	84				10.1016/j.cnsns.2019.105152	Article

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104	Singh S., Melnik R.	Thermal ablation of biological tissues in disease treatment: A review of computational models and future directions
105	Calleja-Ochoa A., Gonzalez-Barrio H., Polvorosa-Teijeiro R., Amigo F.J., Gómez-Escudero G., Fernández-De-Lucio P., Barton M., Bo P., López-De-Lacalle-Marcaide L.-N.	Machining of developable ruled surfaces using mathematical algorithms [Mecanizado de superficies regladas desarrollables mediante algoritmos matemáticos]
106	Kruijer W., Behrouzi P., Bustos-Korts D., Rodríguez-Álvarez M.X., Mahmoudi S.M., Yandell B., Wit E., van Eeuwijk F.A.	Reconstruction of networks with direct and indirect genetic effects
107	Lázaro E., Makowski D., Martínez-Minaya J., Vicent A.	Comparison of frequentist and Bayesian meta-analysis models for assessing the efficacy of decision support systems in reducing fungal disease incidence
108	Law N.C., Marinelli I., Bertram R., Corbin K.L., Schildmeyer C., Nunemaker C.S.	Chronic stimulation induces adaptive potassium channel activity that restores calcium oscillations in pancreatic islets in vitro
109	Müller J., Schenk C., Keicher R., Schmidt D., Schulz V., Velten K.	Optimization of an externally mixed biogas plant using a robust CFD method
110	Hussain T., Muhammad K., Ser J.D., Baik S.W., De Albuquerque V.H.C.	Intelligent Embedded Vision for Summarization of Multiview Videos in IIoT
111	Lê Q.T., Nguyen H.D.	Equivariant motivic integration and proof of the integral identity conjecture for regular functions
112	Touzou I., Nava V., Gao Z., Mendikoa I., Petuya V.	Small scale experimental validation of a numerical model of the HarshLab2.0 floating platform coupled with a non-linear lumped mass catenary mooring system

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Electromagnetic Biology and Medicine	39	2	49	88	10.1080/15368378.2020.1741383	Review
Dyna (Spain)	95	2	125		10.6036/9406	Note
Genetics	214	4	781	807	10.1534/GENE TICS.119.302949	Article
Agronomy	10	4			10.3390/agronomy10040560	Article
American Journal of Physiology - Endocrinology and Metabolism	318	4	E554	E563	10.1152/ajpendo.00482.2019	Article
Computers and Electronics in Agriculture	171				10.1016/j.compag.2020.105294	Article
IEEE Transactions on Industrial Informatics	16	4	2592	2602	10.1109/TII.2019.2937905	Article
Mathematische Annalen	376	3-abr	1195	1223	10.1007/s00208-019-01940-2	Article
Ocean Engineering	200				10.1016/j.oceaneng.2020.107036	Article

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<b>113</b>	Kenig C.E., Ponce G., Vega L.	Uniqueness properties of solutions to the Benjamin-Ono equation and related models
<b>114</b>	Hashemian A., Lakzian E., Ebrahimi-Fizik A.	On the application of isogeometric finite volume method in numerical analysis of wet-steam flow through turbine cascades
<b>115</b>	Beltran D., Cladek L.	Sparse bounds for pseudodifferential operators
<b>116</b>	Veligatla M., Titsch C., Drossel W.-G., Garcia-Cervera C.J., Müllner P.	Sensitivity of twin boundary movement to sample orientation and magnetic field direction in Ni-Mn-Ga
<b>117</b>	Bo P., González H., Calleja A., de Lacalle L.N.L., Bartoň M.	5-axis double-flank CNC machining of spiral bevel gears via custom-shaped milling tools — Part I: Modeling and simulation
<b>118</b>	Xie C., García-Cervera C.J., Wang C., Zhou Z., Chen J.	Second-order semi-implicit projection methods for micromagnetics simulations
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Journal of Functional Analysis	278	5			10.1016/j.jfa.2019.108396	Article
Computers and Mathematics with Applications	79	6	1687	1705	10.1016/j.camwa.2019.09.025	Article
Journal d'Analyse Mathématique	140	1	89	116	10.1007/s11854-020-0083-x	Article
Acta Materialia	186		389	395	10.1016/j.actamat.2020.01.011	Article
Precision Engineering	62		204	212	10.1016/j.precisioneng.2019.11.015	Article
Journal of Computational Physics	404				10.1016/j.jcp.2019.109104	Article
Neural Networks	123		118	133	10.1016/j.neunet.2019.11.021	Article
International Journal of Non-Linear Mechanics	119				10.1016/j.ijnonlinmec.2019.103342	Article
Computer Methods in Applied Mechanics and Engineering	360				10.1016/j.cma.2019.112705	Article

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<b>123</b>	Citores L., Ibaibarriaga L., Lee D.-J., Brewer M.J., Santos M., Chust G.	Modelling species presence–absence in the ecological niche theory framework using shape-constrained generalized additive models
<b>124</b>	Nieto Simavilla D., Sgouros A.P., Vogiatzis G.G., Tzoumanekas C., Georgilas V., Verbeeten W.M.H., Theodorou D.N.	Molecular Dynamics Test of the Stress-Thermal Rule in Polyethylene and Polystyrene Entangled Melts
<b>125</b>	Capo-Rangel G., Gerardo-Giorda L., Somersalo E., Calvetti D.	Metabolism plays a central role in the cortical spreading depression: Evidence from a mathematical model
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<b>128</b>	Del Ser J., Osaba E., Sanchez-Medina J., Fister I., Fister I.	Bioinspired Computational Intelligence and Transportation Systems: A Long Road Ahead
<b>129</b>	Sacco R., Guidoboni G., Jerome J.W., Bonifazi G., Marazzi N.M., Vercellin A.C.V., Lang M.S., Harris A.	A theoretical approach for the electrochemical characterization of ciliary Epithelium
<b>130</b>	Osaba E., Del Ser J., Camacho D., Bilbao M.N., Yang X.-S.	Community detection in networks using bio-inspired optimization: Latest developments, new results and perspectives with a selection of recent meta-heuristics



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Statistics and Computing	30	2	377	404	10.1007/s11222-019-09885-x	Article
Ecological Modelling	418				10.1016/j.ecolmodel.2019.108926	Article
Macromolecules	53	3	789	802	10.1021/acs.macromol.9b02088	Article
Journal of Theoretical Biology	486				10.1016/j.jtbi.2019.110093	Article
Journal of Theoretical Biology	486				10.1016/j.jtbi.2019.110088	Article
Kinetic and Related Models	13	1	97	128	10.3934/krm.2020004	Article
IEEE Transactions on Intelligent Transportation Systems	21	2	466	495	10.1109/TITS.2019.2897377	Article
Life	10	2			10.3390/life10020008	Article
Applied Soft Computing Journal	87				10.1016/j.asoc.2019.106010	Article

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131	Rusconi S., Dutykh D., Zarnescu A., Sokolovski D., Akhmatskaya E.	An optimal scaling to computationally tractable dimensionless models: Study of latex particles morphology formation
132	Thompson M.G., Pearson A.N., Barajas J.F., Cruz-Morales P., Sedaghatian N., Costello Z., Garber M.E., Incha M.R., Valencia L.E., Baidoo E.E.K., Martin H.G., Mukhopadhyay A., Keasling J.D.	Identification, Characterization, and Application of a Highly Sensitive Lactam Biosensor from <i>Pseudomonas putida</i>
133	Cortés E., Escobedo M.	On a system of equations for the normal fluid-condensate interaction in a Bose gas
134	Mazuelas S., Zaroni A., Pérez A.	Minimax classification with 0-1 loss and performance guarantees
135	Vadillo J., Santana R., Lozano J.A.	Exploring Gaps in DeepFool in Search of More Effective Adversarial Perturbations
136	Singh S., Melnik R.	Computational model of radiofrequency ablation of cardiac tissues incorporating thermo-electro-mechanical interactions
137	He X., Du H., Wang D., Wang L., Melnik R.	Modelling ageing phenomenon in ferroelectrics via a Landau-type phenomenological model

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ACS Synthetic Biology	9	1	53	62	10.1021/acssynbio.9b00292	Article
Journal of Functional Analysis	278	2			10.1016/j.jfa.2019.108315	Article
Advances in Neural Information Processing Systems	2020-December					Conference Paper
Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	12566 LNCS		215	227	10.1007/978-3-030-64580-9_18	Conference Paper
ASME International Mechanical Engineering Congress and Exposition, Proceedings (IMECE)	5				10.1115/IMECE2020-23367	Conference Paper
Smart Materials and Structures	30	1			10.1088/1361-665X/abcca2	Article

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<b>145</b>	García-Cervera C.J., Giorgi T., Joo S.	Boundary vortex formation in polarization-modulated orthogonal smectic liquid crystals

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Pure and Applied Mathematics Quarterly	16	4	1053		0.4310/PAMQ-2020.v16.n4.a6	Article
Revista Matematica Complutense				1066	10.1007/s13163-020-00376-6	Article
SIAM Journal on Mathematical Analysis	52	5	5196		10.1137/20M1324946	Article
Mathematics In Engineering	2	2	290	5212	10.3934/mine.2020015	Article
Foundations of Computational Mathematics				312	10.1007/s10208-020-09475-8	Article
Proceedings - 2nd International Conference on Mathematics and Computers in Science and Engineering, MACISE 2020			145	148	10.1109/MACISE49704.2020.00031	Conference Paper
Trends in Mathematics			235	242	10.1007/978-3-030-47174-3_14	Book Chapter
SIAM Journal on Applied Mathematics	80	5	2024	2044	10.1137/19M1301618	Article

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<b>149</b>	Beltran D., Hickman J., Sogge C.D.	Variable coefficient wolff-type inequalities and sharp local smoothing estimates for wave equations on manifolds
<b>150</b>	Di Plinio F., Hytönen T.P., Li K.	Sparse bounds for maximal rough singular integrals via the fourier transform
<b>151</b>	Singh S., Melnik R.	Microtubule biomechanics and the effect of degradation of elastic moduli
<b>152</b>	Rivera J.A., Pardo D., Alberdi E.	Design of loss functions for solving inverse problems using deep learning

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Groups, Geo- metry, and Dynamics	14	2	689	704	10.4171/GGD/ 559	Article
Communi- cations in Contemporary Mathematics					10.1142/S021 9199720500285	Article
Analysis and PDE	13	2	403	433	10.2140/apde. 2020.13.403	Article
Annales de l'Institut Fourier	70	5	1871	1902	10.5802/AIF. 3354	Article
Lecture Notes in Computer Science (inclu- ding subseries Lecture Notes in Artificial In- telligence and Lecture Notes in Bioinforma- tics)	12142 LNCS		348	358	10.1007/978-3-0 30-50433-5_27	Conference Paper
Lecture Notes in Computer Science (inclu- ding subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	12139 LNCS		158	171	10.1007/978-3- 030-50420-5 _12	Conference Paper

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<b>154</b>	Ignat R., Nguyen L., Slastikov V., Zarnescu A.	On the uniqueness of minimisers of Ginzburg-Landau functionals
<b>155</b>	Singh S., Melnik R.	Coupled Electro-mechanical Behavior of Microtubules
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Annales Scientifiques de l'Ecole Normale Supérieure	53	3	589	613	10.24033/asens.2429	Article
Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	12108 LNBI		75	86	10.1007/978-3-030-45385-5_7	Conference Paper
SIAM Journal on Applied Mathematics	80	2	1034	1056	10.1137/19M1272755	Article
Procedia Manufacturing	42		235	238	10.1016/j.promfg.2020.02.075	Conference Paper
Contemporary Mathematics	742		109	135	10.1090/conm/742/14941	Conference Paper
Contemporary Mathematics	742		189	200	10.1090/conm/742/14945	Conference Paper

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Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	11968 LNCS		304	318	10.1007/978-3-030-38629-0_25	Conference Paper
Lecture Notes in Computational Science and Engineering	132		155	164	10.1007/978-3-030-30705-9_14	Conference Paper
Proceedings of the 6th European Conference on Computational Mechanics: Solids, Structures and Coupled Problems, ECCM 2018 and 7th European Conference on Computational Fluid Dynamics, ECFD 2018			2079	2088	10.3390/en13030740	Conference Paper

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165	Page G.L., Rodríguez-Álvarez M.X., Lee D.-J.	Bayesian hierarchical modelling of growth curve derivatives via sequences of quotient differences
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169	Cassano B., Pizzichillo F., Vega L.	A Hardy-type inequality and some spectral characterizations for the Dirac–Coulomb operator
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SOURCE TITLE	VOLUME	ISSUE	PAGE START	PAGE END	DOI	DOCUMENT TYPE
Energies	13	3				Article
Journal of the Royal Statistical Society. Series C: Applied Statistics					10.1111/rssc.12399	Article
CISM International Centre for Mechanical Sciences, Courses and Lectures	598		361	392	10.1007/978-3-030-35558-6_8	Book Chapter
Monatshefte für Mathematik	191	1	125	173	10.1007/s00605-019-01349-8	Article
Neural Networks	121		88	100	10.1016/j.neunet.2019.09.004	Article
Revista Matemática Complutense	33	1			10.1007/s13163-019-00311-4	Article
Information Fusion	53		222	239	10.1016/j.inffus.2019.06.004	Article
GLIA	68	1	5	26	10.1002/glia.23632	Review
Journal of Geometric Analysis	30	1	706	718	10.1007/s12220-019-00162-x	Article
Revista Matemática Complutense	33	1	197	230	10.1007/s13163-019-00297-z	Article



SEVERO OCHOA  
STRATEGIC  
RESEARCH LAB  
PROGRAM

**7.**

The BCAM Severo Ochoa Strategic Laboratory program, launched in 2020, consists on the collaboration with renowned researchers in the areas of interest of BCAM supporting the development of leading research groups at BCAM. This program is directed towards exceptional researchers in Mathematics and related areas from all over the world at both early stage and experienced levels in specific hot topics in the field of Applied Mathematics and its interface with other disciplines.

This program highlights the importance of international collaboration between research centers and universities, as well as the strengthening that this can mean for the center's lines of research and its international positioning.

The common objectives of these joint laboratories are:

- To promote collaborative research on hot topics, and thus strengthen the center's research areas and generate synergies.
- To contribute to BCAM projects.
- Explore the connection between pure/applied mathematics and new research topics in collaboration with BCAM research areas.
- Strengthen contacts within the international scientific community
- To provide specialized training to the members of the center.

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This initiative is part of the actions promoted by BCAM thanks to the accreditation of "Severo Ochoa Centre of Excellence" granted by the Ministry of Science and Innovation through the State Research Agency and that BCAM has for the period 2018-2022.



The current BCAM Severo Ochoa Strategic Labs are the following:

**1. Severo Ochoa Strategic Lab on Modelling with Partial Differential Equations in Mathematical Biology, chaired by Prof. Jose A. Carrillo (U. Oxford, UK) and Prof. Elena Akhmatskaya (BCAM-Ikerbasque).**

BCAM has the collaboration of Prof. Jose Antonio Carrillo, who is leading an ERC Advanced Grant 2019 project for the development of non-local PDE for complex particle dynamics: phase transitions, patterns and synchronization. The laboratory will be co-led by Prof. Elena Akhmatskaya, Ikerbasque Professor at BCAM who coordinates the area of mathematical modelling with multidisciplinary applications.



Mathematical  
Institute

**About Jose Antonio Carrillo:** Prof. Carrillo is Professor of the Analysis of Nonlinear Partial Differential Equations in the Mathematics Institute, Oxford University and Tutorial Fellow in Applied Mathematics, The Queen's College. In 2019 he was awarded an ERC Advanced grant Nonlocal-CPD ("Nonlocal PDEs for Complex Particle Dynamics: Phase Transitions, Patterns and Synchronization"). His research field is Partial Differential Equations (PDE), the modelling based on PDEs, their mathematical analysis, the numerical schemes, and their simulation in applications are his general topics of research.

**2. Severo Ochoa Strategic Lab on Trustworthy Machine Learning, chaired by Dr. Novi Quadrianto (U. Sussex, UK) and Prof. Jose A. Lozano (BCAM - UPV/EHU).**

In this joint lab, BCAM counts on the collaboration of Dr. Novi Quadrianto, who is leading an ERC Starting Grant 2019 project on "Bayesian Models and Algorithms for Fairness and Transparency (BayesianGDPR)". The laboratory will be co-led by Prof. Jose A. Lozano, BCAM Scientific director who coordinates the BCAM area of Data Science & Artificial Intelligence.



**About Novi Quadrianto:** Dr Novi Quadrianto is currently Reader in Machine Learning (Informatics) School of Engineering and Informatics. In 2020 he was awarded an ERC Starting grant BayesianGDPR ("Novel Bayesian approach for fair, lawful and transparent data processing"). His research focuses on "Responsible AI". The key research goal of "Responsible AI" is to develop new artificial intelligence and machine learning models that embed fairness, accountability, transparency, and trustworthiness into them for ensuring ethical outcomes and long-term public confidence in the deployment of automated systems.



**3. Severo Ochoa Strategic Lab on Analysis of PDEs, chaired by Prof. Joaquim Serra (ETH Zurich, SZ) and Prof. Luis Vega (BCAM – UPV/EHU).**

In collaboration with Prof. Joaquim Serra, ETH Zurich, ERC Starting grant 2020 on Stable Interfaces: phase transitions, minimal surfaces, and free boundaries. The laboratory is co-led by Prof. Luis Vega, coordinator of the APDE research area.

This Joint Lab aims to promote research collaborations in the interplay between Partial Differential Equations and Mathematical Analysis and their relation with Geometry and Fluid Mechanics, and thus reinforce existing research areas and generate synergies.

**ETH** zürich

**About Joaquim Serra:** Joaquim Serra's research focuses on elliptic partial differential equations. These mathematical equations describe many natural phenomena such as waves, heat, electric and gravitational potential, fluid dynamics and quantum mechanics. In 2020 this internationally acclaimed mathematician received both a prestigious EMS Prize from the European Mathematical Society and an ERC Starting Grant for his outstanding research results. He is currently Assistant Professor of Mathematics at ETH Zurich.



KNOWLEDGE  
TRANSFER UNIT

8.

The aim of BCAM Knowledge Transfer Unit is structured around four main objectives:



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One of BCAM's most important missions is to spread knowledge and technology in the industry and the society in general.

It is critical for the Basque Center for Applied Mathematics to transfer the obtained research results to sectors as biosciences, health, energy, advanced manufacturing, telecommunications and transport, including local, national and international entities.

For that purpose, BCAM offers expertise in many research fields to SMEs and large industrial groups, and supports the creation of new companies.

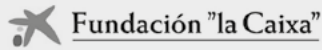
These are the collaboration models:

- Strategic partnerships
- Collaborative R&D&I projects
- Joint positions / research teams
- Supervision of Master and PhD Students
- Training courses
- Organization of dissemination activities

## JOINT POSITIONS



## COLLABORATIONS





MEDIA  
AND OUTREACH  
ACTIVITIES

9.

From the beginning BCAM has identified the need to bring mathematics closer to society, working to show the value of mathematics. To do so, it has focused on showing the value of mathematical research, incorporating a gender perspective and encouraging scientific vocations. In addition, it has aimed to consolidate the presence of the center in the digital environment to continue building a community in the networks.

## DISSEMINATION FOR PUBLIC IN GENERAL

- **BCAM Naukas pi-day**

Event to celebrate Maths Day, Pi Day, together with Naukas, to disseminate about mathematics to students and the general public.

BCAM's work in this initiative has been the collaboration in the organisation and participation of researchers giving some of the talks.



- **“Matemáticas en la vida cotidiana”**

It is a series of scientific dissemination meetings that aim to bring mathematics and its reality closer to society in general in an entertaining but rigorous way.

Dae-Jin, leader of the Applied Statistics line, participated in one of the talks under the title 'Mathematics + Innovation: the secret formula for digital transformation and startups'.

- **Pint of Science**

The Pint of Science festival aims to deliver interesting and relevant talks on the latest science research in an accessible format to the public – mainly across bars, pubs, cafes and other public spaces. It wants to provide a platform which allows people to discuss research with the people who carry it out and no prior knowledge of the subject is required.

Carlos Uriarte and Tamara Dancheva, PhD Students at BCAM, would participated in this initiative talking about “How to look under stones by learning with mathematics” and “The importance of the microstructure and properties of materials”.





- **European Researchers Night from Bilbao**

The European Researchers' Night programme takes place simultaneously in 350 European cities and its purpose is to be a bridge between the world of research and the general public in order to raise awareness of the benefits that researchers' work brings to society and its impact on everyday life.

Jose Antonio Lozano, Scientific Director of BCAM, gave one of the talks that took place in this initiative. In his case, he spoke about "Artificial intelligence and mathematics to analyze the pandemic". In addition, Dae-Jin Lee, gave a workshop on explaining the future of Covid through data and simulations.

- **Activities for promoting scientific vocations**

#### FIRST LEGO LEAGUE



FIRST LEGO League Euskadi is an international educational programme in which more than 560,000 schoolchildren aged between 6 and 16 from 110 countries around the world participate. Its aim is to awake young people's interest in science and technology. Through fun, group learning experiences with real thematic challenges, skills in the scientific and digital world are developed and values such as discovery, innovation, inclusion and teamwork are promoted.



Dae-Jin Lee, with the help of researchers and student of the center, showed the work done at BCAM through a talk entitled "What are mathematics?" for the student who participated in the project and visited the center.

Ander Carreño and Onintze Zaballa, PhD Students at BCAM, also participated in it. Both of them taught visitors the basic principles of mathematics, machine learning and artificial intelligence and how to apply artificial intelligence in their projects.

#### STEAM SARE



STEAMsare is a project created by the Education department of the Basque Government with the collaboration of Innobasque. The programme has created a school, companies and scientific-technological agents' network, in which part BCAM participates, to promote STEAM education in the Basque Country. STEAMsare among many different activities, offers the students a real context in science, maths o technology and shows the labour reality, the diversity of professional profiles and the richness of the Basque industrial fabric.

Miguel Camarasa and Gorka Kobeaga, participated in this initiative to promote STEM careers in students. Each of them gave a talk in a school about their research to show about mathematics applications.





### JAKIN-MINA

This is a program for young people in the 4th year of Secondary School in the Basque Country and Navarre and consists of a series of lectures in multiple disciplines, given by leading experts in their respective fields.

David Pardo participated in this project, with a conference titled “From Haro to New York: A boat trip exploring the Earth’s subsurface through applied mathematics”.

## COLLABORATION WITH “CÁTEDRA DE CULTURA CIENTÍFICA” OF UPV/EHU



- **Contribution to Mapping Ignorance Blog**

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A blog that presents research articles that are carried out in an easy-to-understand language so that everyone can understand them.



- **Occasional appearances in the blog Zientzia Kaiera**

A blog with the aim of bringing science closer to the general public in Basque.

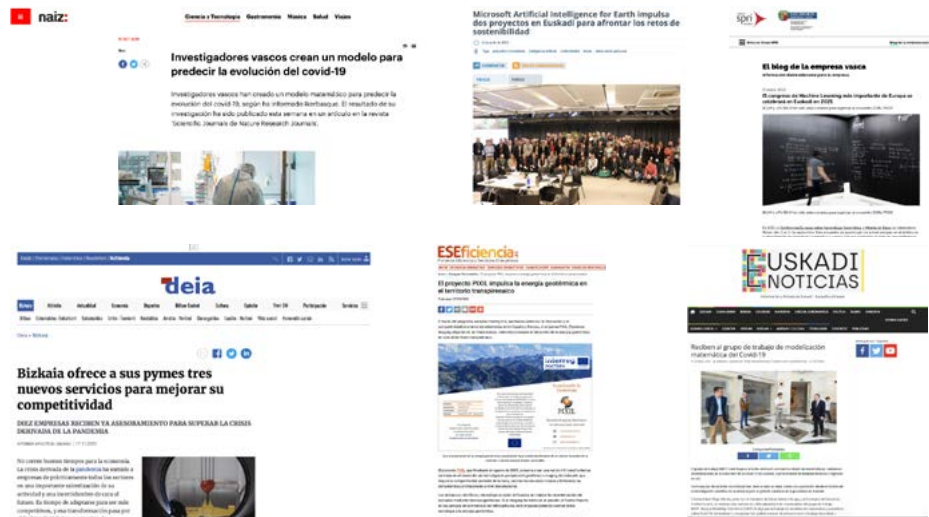
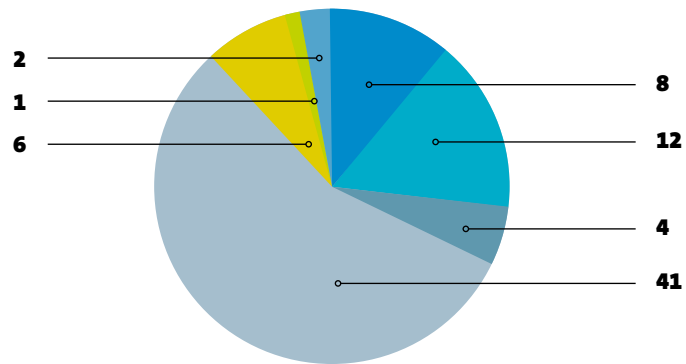
\* Due to the situation caused by Covid-19, some of the outreach activities had to be cancelled: BCAM-Naukas Pi day and Pint of Science.

# BCAM IN THE MEDIA

During 2020 BCAM has appeared in the media for different reasons. One of the main ones has been the COVID-19 issue, considering the research that is being carried out on it. Another important one was the ECML PKDD 2020 Conference, which unfortunately had to be cancelled, due to current situation.

We also had the welcome of the Lehendakari to the group working on the mathematical modelling of COVID. Other reasons for press coverage are projects such as JRL-ORE or PIXIL, and collaborations such as the one with Beaz, the public company of the Provincial Council of Bizkaia that offers support to companies and entrepreneurs.

- Blog
- Others
- Print media
- Online media
- Radio
- Social media
- Television

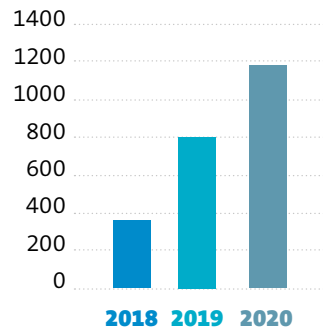


# SOCIAL MEDIA

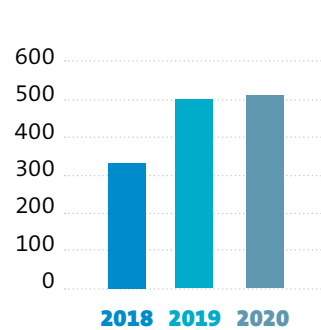
## TWITTER

	2018	2019	2020
<b>Tweets</b>	341	504	510
<b>Impressions</b>	294018	686634	636300
<b>Profile visits</b>	6610	8391	15142
<b>Retweets</b>	518	1177	956
<b>Likes</b>	1365	2466	2415
<b>Followers</b>	353	793	1178

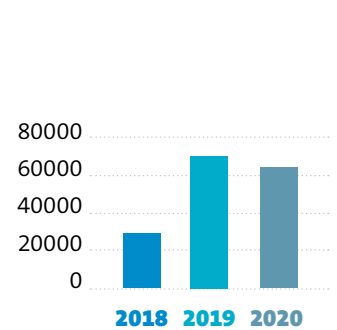
**Followers**



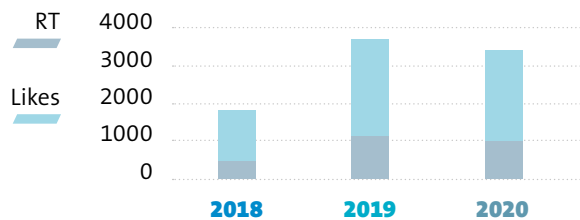
**Tweets**



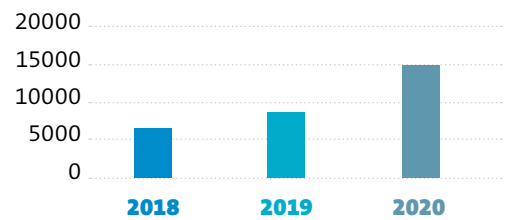
**Impressions**



**RT and Likes**



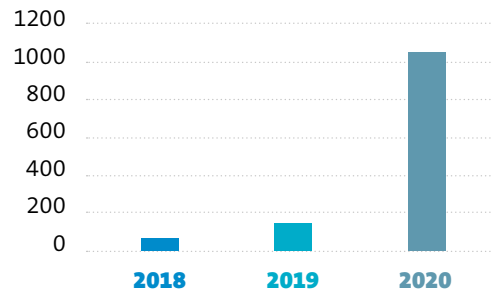
**Visits**



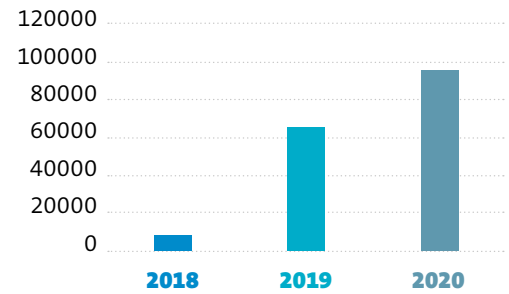
## LINKEDIN

	2018	2019	2020
<b>Tweets</b>	56	143	1077
<b>Impressions</b>	7443	68588	96966
<b>Reactions</b>	90	714	910
<b>Shares</b>	2	48	67

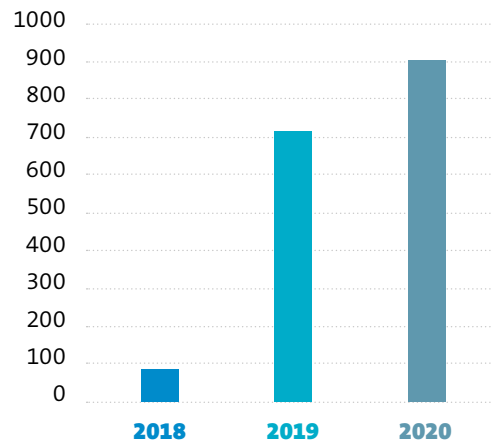
### Followers



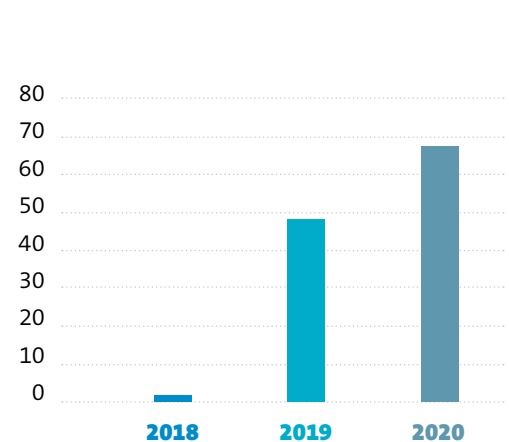
### Impressions



### Reactions



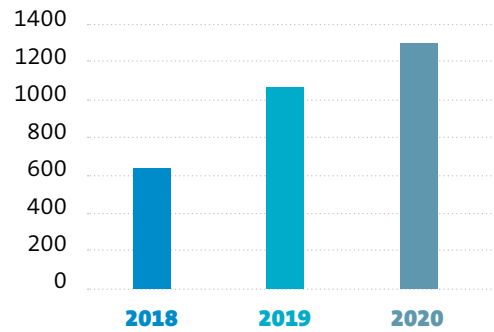
### Shares



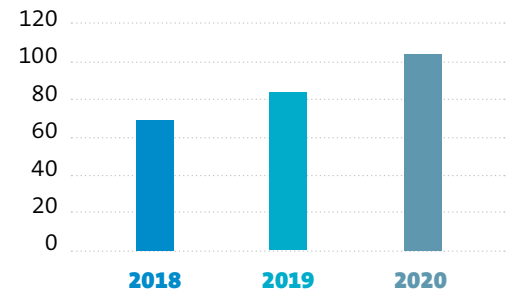
## YOUTUBE

	2018	2019	2020
<b>Views</b>	627	1100	1300
<b>Subscribers</b>	71	87	106
<b>Impressions</b>	4400	12900	15000

### Views

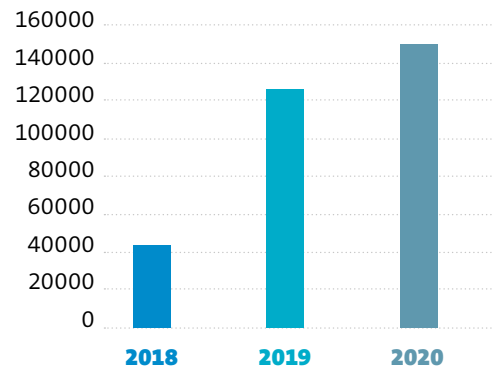


### Subscribers



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### Impressions





# GENDER EQUALITY ACTIONS

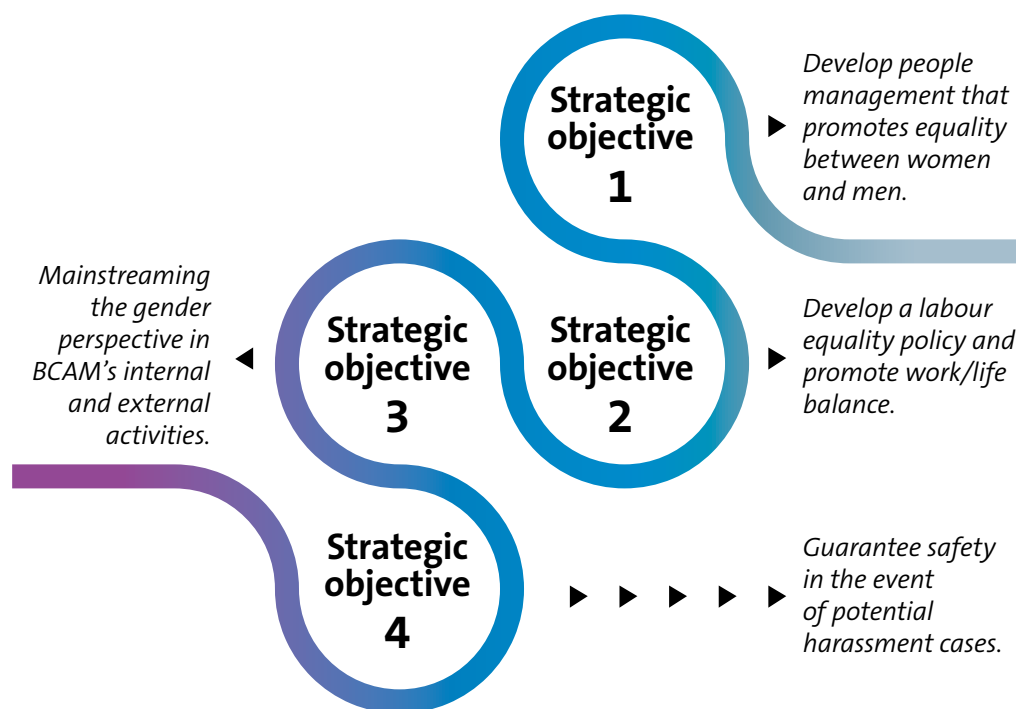
**10.**

On 2019, BCAM launched his first Equality Plan. This plan, which has an implementation from 2019 to 2021, has principles and actions that are framed within and linked to equality regulations and legislation that regulate actions, aimed at eliminating inequalities and promoting effective and real equality between women and men in the international area.

**BCAM Gender Equality Plan aims to:**

- Reduce access gaps for women in all spaces and positions.
- Drive work/life balance measures and an organisational culture that values care and guarantees women's safety.
- Incorporate gender vision in the organisation's activities.
- Integrate the gender perspective in policies.
- Raise awareness among staff about the impact of gender roles and stereotypes in general, and their specific reality in the workplace.
- Value abilities, skills, work methods and leadership outside of patriarchal values.

To achieve these objectives, Basque Centre of Applied Mathematics equality plan is structured around four objectives. Several expected results are derived from each one of them and different activities are proposed to achieve them.



To achieve the objectives, BCAM has carried out several actions during 2020 described in the following table:

## GENDER EQUALITY ACTIONS 2020

### 1 Actions in media platforms

Twitter contest to choose the female mathematician to name BCAM seminar room (prize: Illustrated scientific calculator). The seminar room was named after a female mathematician: Maryam Mirzakhani.



*“The beauty of mathematics  
shows itself to patient followers”*

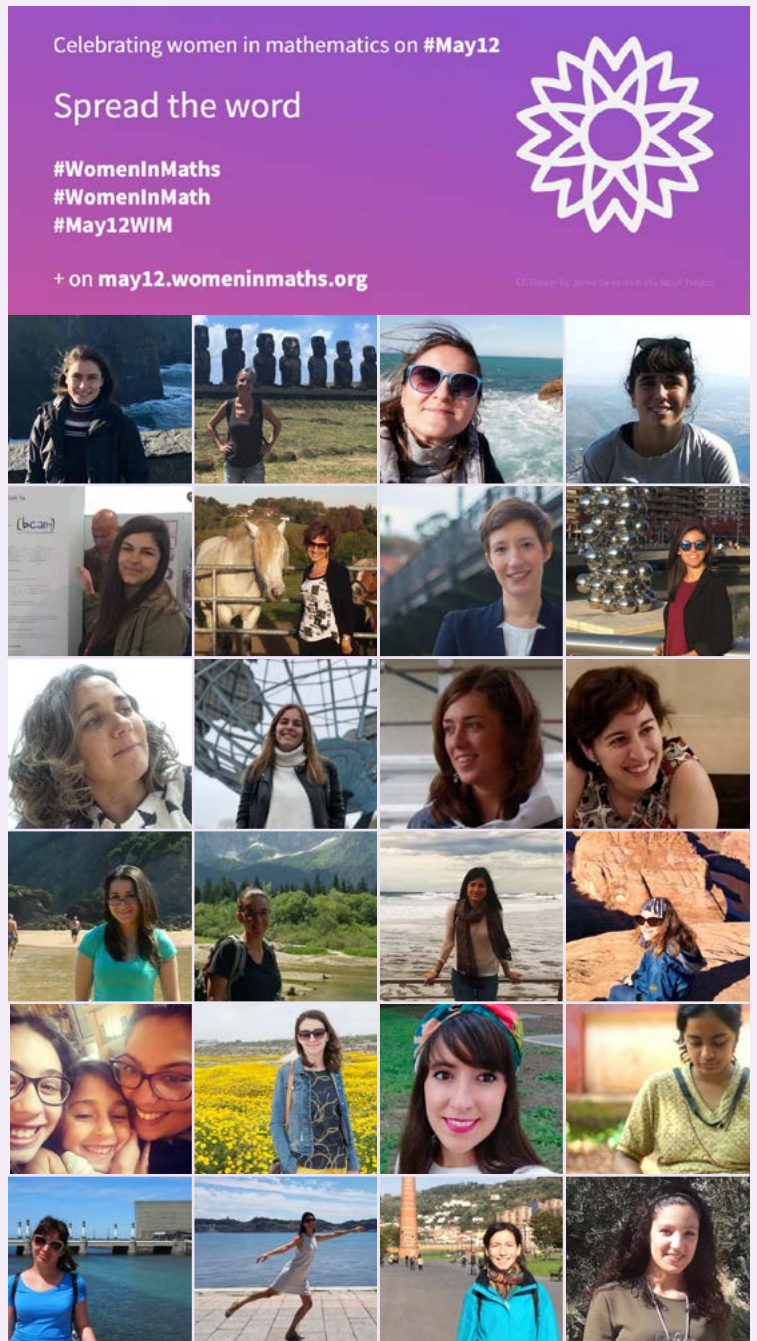
*Maryam Mirzakhani*

11F, an initiative was launched for female researchers to write web articles about the women scientists who have inspired them.





On the occasion of 12M (International Day of Women Mathematicians) we published a series of tweets to raise awareness of our female researchers.



## 2 Participation in gender equality promotion programs

- Incorporation as institutional member of the European Women in Mathematics.



- Participation and collaboration in Gender Equality promotion dissemination events: radio, press, social networks....
- Participation in SOMMA's Gender Equality Working Group.



- Sponsorship for the "Mujeres con Ciencia" web of the UPV/EHU Scientific Culture Chair by the project 77778 - MATHROCKS (H2020).

Support and encourage women to take part in R Ladies, in order to promote gender diversity in the R community.



Collaboration with Women for Africa Foundation (FMxA) to host an African researcher for six months in the “Science by Woman” program.

BCAM participates in the “STEAM Sare a Empresas y Colegios” organized by INNOBASQUE.

Collaboration in the talent and diversity management report with Bizkaia Talent and PWN Bilbao to raise awareness in the science & technology sector about new leadership profiles.

### 3 Training and awareness

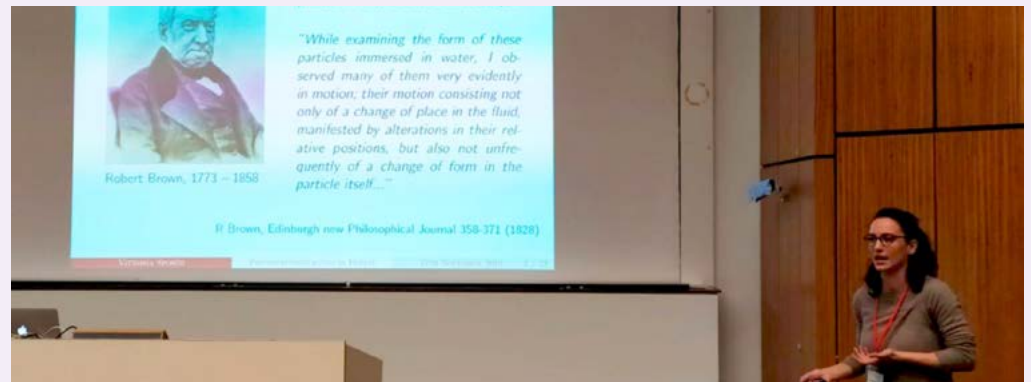
- Creation of an Equality Commission and definition of objectives and functions.
- Encourage more women to be invited to give Seminars and Workshops at BCAM in order to increase the female presence in the scientific activities carried out at BCAM (set a minimum target of 25% women).
- Internal communication on actions of the equality plan that are being carried out.
- Equality training for all employees in Spanish and English .
- Development of a “work-life balance” policy.

In terms of participation and collaboration in the promotion and dissemination of Gender Equality, several events have been held in which BCAM members have taken part:

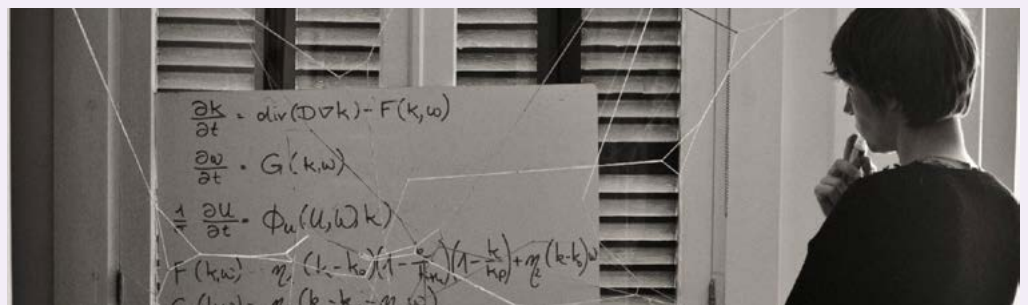
- Dr. Luz Roncal, Ikerbasque researcher and Ramón y Cajal fellow in Harmonic Analysis, obtained the Prize for Young Female Scientific Talent in the category of mathematics.
- Prof. Elena Akhmatkaya participated in the conference “Women in science and technology”.
- BCAM representatives have attended to the presentation of the report “Talent Management and Diversity: new leadership profiles.



- Prof. Javier F. Bobadilla, Ikerbasque research professor and group leader of Singularity Theory and Algebraic Geometry, talked on the radio about Karen Ulhenbeck when she was awarded the Abel Prize (the first time it was given to a woman).
- Dr. Luz Roncal participated in a round table on the challenges of the scientific career and the situation of women researchers in the framework of the 11F initiatives. The open debate “Conversations in the Academy: Dialogues in plural feminine” was organized by the Spanish Association of Scientific Communication and the Royal Academy of Exact, Physical and Natural Sciences.
- Dr. Christina Schenk, Postdoctoral Fellow, gave a virtual talk at San Felix School in Ortuella to 13-year-old students to raise awareness of her work as a mathematician and to highlight the work of women in scientific careers in the framework of the 11F initiatives.
- Vittoria Sposini, PhD student, gave a presentation of “Beyond the realm of Brownian motion” at the Conference for Women in Physics in Berlin.



- Lore Zumeta, PhD student, gave a lecture on science to the students of PAGASARRIBIDE IPI eskola in the framework of the INSPIRA STEAM program.
- BCAM former PhD student Dr. Julia Kross has collaborated in the promotion of “Her Math Story”, where stories of other BCAM former PhD students are also included. BCAM has contributed to the dissemination of this initiative.



## ABOUT COLLABORATIONS

On 2019, BCAM launched his first Equality Plan. This plan, which has an implementation from 2019 to 2021, has principles and actions that are framed within and linked to equality regulations and legislation that regulate actions, aimed at eliminating inequalities and promoting effective and real equality between women and men in the international area.



### **MatEsElla**

At national level, BCAM is one of the sponsors of MatEsElla, an initiative between the Spanish Royal Mathematical Society (RSME) and the Spanish Association of Executives and Advisors (EJE&CON) to promote scientific or entrepreneurial careers among women undergraduate or master's degree students in STEM disciplines (science, technology, engineering and mathematics). It also seeks to promote the careers of women researchers who participate as mentors.



### **INSPIRA project**

BCAM signed last June a commitment to support the INSPIRA project and has joined the manifest. INSPIRA project has the objective to promote STEAM (Science, Technology, Engineering, Arts and Maths) professions among girls in the Basque Country. It is based on awareness-raising and guidance actions, given by women professionals from the research world, science and technology.



### **Women for Africa Foundation**

The Women for Africa Foundation (FMxA), in line with its mission of contributing to the development of Africa through the drive of its women, has the aim to promote African women's leadership in scientific research and technology transfer and to foster the capacity of the research centres in their home countries. Due to the signed agreement, BCAM will host an African woman scientist in the 6th edition of the programme. The main goal is to enable African women researchers and scientists to tackle the great challenges faced by Africa through research in health and biomedicine, sustainable agriculture and food security, water, energy and climate change.



### **R-Ladies is a worldwide organization**

The R-Ladies is a worldwide organization whose mission is to promote gender diversity in the R community. The primary focus is on supporting minority gender R enthusiasts to achieve their programming potential, by building a collaborative global network. BCAM has helped to welcome the first meet-up for the R-ladies in Bilbao and has many members of the centre in the group.

The background features a series of overlapping, semi-transparent blue geometric shapes, including squares and rectangles with rounded corners, arranged in a pattern that suggests movement and depth. The colors range from light sky blue to a deeper cerulean blue.

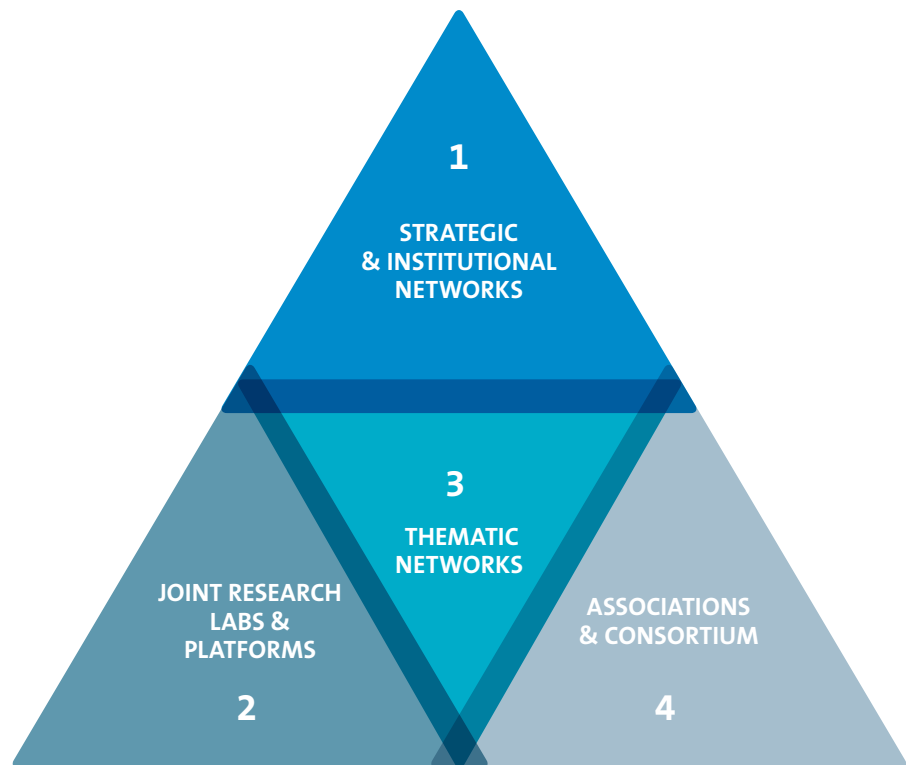
# NETWORKS AND AGREEMENTS

**11.**



Being a multidisciplinary center, collaboration between institutions and researchers is fundamental for the Basque Center for Applied Mathematics. Currently, BCAM belongs to some of the most important national and international networks in its field.

We organized our participation in these networks and consortiums in the following way:



# 11.1.

## NETWORKS, JOINT LABS AND PLATFORM

### 1. STRATEGIC & INSTITUTIONAL NETWORKS



#### **ERCOM: European Research Centers on Mathematics**

<https://euro-math-soc.eu/committee/ercom>

ERCOM is an EMS committee consisting of Scientific Directors of European Research Centers in the Mathematical Sciences, or their chosen representatives. Only European centers which are institutional members of the EMS, predominantly research oriented, with an international scientific board and a large international visiting program, covering a broad area of the Mathematical Sciences are eligible for representation in ERCOM. The eligibility of centers is decided by the EMS Executive Committee after consultations with ERCOM. BCAM is part of the committee since 2016 and was expected to host the ERCOM meeting 2020 that was postponed due to the COVID - 19 outbreak.

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#### **EUMATH-IN: European Network of Mathematics and Industry**

<https://eu-maths-in.eu>

EU-MATHS-IN aims to leverage the impact of mathematics on innovations in key technologies by enhanced communication and information exchange between and among the involved stakeholders on a European level. Our contribution in this network is to be part as an Institutional Member.

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#### **EWM: European Women in Mathematics**

<https://www.europeanwomeninmaths.org>

European Women in Mathematics' main objective is to encourage women to study mathematics and support women in their careers. European Women in Mathematics is an international association of women working in the field of mathematics in Europe. Founded in 1986, EWM has several hundred members and coordinators in 33 European countries. Our contribution in this network is to be part as an Institutional Member.



**SOMMA: The ‘Severo Ochoa’ Centers and ‘Maria de Maeztu’ Units of Excellence Alliance**

<https://www.somma.es>

SOMMa is the alliance of “Severo Ochoa” Centres and “María de Maeztu” Units to promote Spanish Excellence in research and to enhance its social impact at national and international levels.

Our contribution in this network is in different levels: member of the executive committee, coordination the Open Science Working Group and participation in different working groups such as Gender Balance, Transfer knowledge, Management, etc. We are part of this network since 2014.



**REM: Strategic Network in Mathematics**

<https://institucionales.us.es/remimus/>

The objective is to create a strategy that will enhance the international presence, creating synergies between mathematical scientific community and the socioeconomic impact of research in Spanish mathematics.

Our contribution in this network is the coordination of the full network during the period 2020-2021 and part of the board of trustees since 2018. We are part of this network since 2018.

## 2. JOINT RESEARCH LABS & PLATFORMS



### LTC-TRANSMATH: Joint Transborder Laboratory in Mathematics

<https://euskampus.eus/en/programmes-en/euskampus-bordeaux/about-the-campus/joint-transborder-laboratories>

The Laboratories for Transborder Cooperation (LTCs) are a formula for collaboration that has been developed since 2015 in the frame of the Campus Euskampus (UPV/EHU)- U. Bordeaux. LTCs were created to provide an institutional framework for research teams from the Basque country and from Bordeaux working together. This framework supports Transborder research communities, which involve young and senior researchers, students, and technicians that can move from one lab to the other without boundaries and share a common vision and action agendas. BCAM leads the TRANSMATH LTC on Applied Mathematics, which objectives are increase scientific outputs and visibility of our joint research at the EU and international level and act as an incubator for larger projects to attract external funding and create a sustainable transnational community of researchers (from students to senior researchers).



### PET MSO-ED: Spanish Platform for Modelling, Simulation and Optimisation Technologies in a Digital Environment

<http://math-in.net/?q=es/content/pet-mso-ed>

The overall objective of the Spanish Platform for Modeling, Simulation and Optimization Technologies in a Digital Environment (PET MSO-ED) is to enhance and strengthen collaboration in R&D&I between the public and business sectors, taking advantage of the potential of mathematics to address the challenges posed in the industrial world and in society. The aim is to provide the Spanish industrial, academic and business research and innovation community with a comprehensive and well-coordinated infrastructure for all the needs related to the adoption and development of Mathematical Modeling, Simulation and Optimization Technologies taking advantage of the resources of Data Science in a Digital Environment. BCAM institutional member of this platform since its promotion in 2021.



### Joint Research Lab on Offshore Renewable Energy (JRL-ORE)

<https://jrl-ore.com>

The Joint Research Laboratory on Offshore Renewable Energy, based in the Basque Country, is composed of researchers from BCAM, TECNALIA and UPV/EHU.

The launch of the JRL-ORE seeks to strengthen the research links between the parties in order to take advantage of synergies between them and to reach critical masses in the agreed scientific and technological areas. It aims to increase the level of the research results in terms of their impact in the business world and society in general.



### Joint Research Lab on Artificial Intelligence (JRL-AI)

<https://jrlab.science>

The Joint Research Lab on Artificial Intelligence, based in the Basque Country, is composed of researchers from BCAM, TECNALIA and UPV/EHU.

The research areas cover various topics such as time series analysis, stream learning, optimization, Lifelong ML or adversarial ML. The applications can be related with transport, data science, industry, energy, architecture... or even agriculture or special engineering.

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## 3. “AULAS” BCAM – UPV/EHU IN DONOSTIA-SAN SEBASTIAN AND LEIOA



So as to get research closer to university degree students and promote knowledge transfer, BCAM has set up an agreement with the University of the Basque Country so as to launch a Joint Research Lab UPV/EHU – BCAM in the faculty of Computer Science and a Joint Research Lab UPV/EHU – BCAM in the Department of Mathematics. Both of them aim to strengthen the fields of scientific and technological research in areas of knowledge of mutual interest.

## 4. THEMATIC NETWORKS



### **MATH-IN Spanish Network of Mathematics and Industry**

<http://www.math-in.net>

Math-in is focused on transferring mathematical technology to business and industrial sectors, thus stimulating an increase in competitiveness in the research groups involved and industry itself. Our contribution in this network is the participation of our more applied research groups in different research projects and the organization of biannual European Study Group with Industry (ESGI).

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### **VHEARTSN: Spanish Network of Research in Cardiac Computational Modeling**

<http://redmodcard.webs.upv.es>

The objective of the VHEARTSN network is to promote collaboration between different Spanish groups with extensive experience in the field of cardiac computer modeling, with the general objective of facilitating and accelerating the development, implementation and application of computational models in biomedical research. We participated in this network by the MMB BCAM Research group from 2016 to 2020.

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### **BIOSTATNET National Network of Biostatistics**

<https://biostatnet.com>

It aims to link together Spanish researchers in biostatistics with an integrative, multidisciplinary, flexible, and open focus.

We participated in this network by the AS (Applied Statistics) BCAM Research group since 2016.

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### **CLISYNE Clinical Systems Neuroscience**

<https://clisyne.org>

The overarching goal of the Clinical Systems Neuroscience (CLISYSNE) network is to identify research avenues for the diagnosis and treatment of diseases of the Central Nervous System (CNS) by applying concepts and analytical tools from Systems Biology and Systems Neurosciences to CNS drug and biomarker discovery. We participated in this network by the MCEN (Mathematical and Computational Neurosciences) BCAM Research group since 2020.

## 5. ASSOCIATIONS & CONSORTIUM



**ECMI: European Consortium for Mathematics in Industry**  
<https://ecmiindmath.org>

The European Consortium for Mathematics in Industry (ECMI) is a consortium of academic institutions and industrial companies that acts co-operatively with the following aims: i) To promote and support the use of mathematical modelling, simulation, and optimization in any activity of social or economic importance, ii) to educate Industrial Mathematicians to meet the growing demand for such experts and iii) to operate on a European scale.

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**EOSC European Open Science Cloud**  
<https://eosc-portal.eu>

The European Open Science Cloud (EOSC) initiative will offer researchers a virtual environment with open and seamless services for storage, management, analysis and re-use of research data, across borders and scientific disciplines by federating existing data infrastructures.

EOSC is being co-created in a series of funded projects and initiatives from Member States and Associated Countries. These will be reflected on this site in time, but the current focus is on the EOSC Association. We are observers in this action.

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**CLAIRE - Confederation of Laboratories for Artificial Intelligence Research in Europe**  
<https://claire-ai.org>

CLAIRE seeks to strengthen European excellence in AI research and innovation. Its extensive network forms a pan-European Confederation of Laboratories for Artificial Intelligence Research in Europe. CLAIRE was launched in 2018 as a bottom-up initiative by the European AI community and aims for “brand recognition” similar to CERN. As part of BCAM contribution to the promotion of Mathematics & Artificial Intelligence, we are members of the Claire Research network.



### BCSC Basque CyberSecurity Centre

<https://www.basquecybersecurity.eus/en/>

BCSC (Basque CyberSecurity Centre) is the organization appointed by the Basque Government to promote cybersecurity. Its mission is to promote and develop culture and awareness on cybersecurity in the Basque society, to streamline business activities concerning cybersecurity and to create a strong professional sector. It is a cross-cutting initiative which represents the Basque Government's commitment to its citizens and companies in the field of cybersecurity. BCAM is part of the BCSC, and collaborates with its partners in several research projects through its "artificial intelligence and cybersecurity laboratory", part of the BDIH assets (see below).

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### BDIH: Basque Digital Innovation Hub

<https://basqueindustry.spri.eus/es/basque-digital-innovation-hub/>

The Basque Digital Innovation Hub (BDIH) is a connected network of assets and services Infrastructure for training, research, testing and validation available for companies. The nodes of the BDIH are: flexible robotics, additive manufacturing, smart & connected machines, digital electricity grids data driven solutions, new materials, medical devices and digital health, cybersecurity.

Artificial  
intelligence and  
cybersecurity  
laboratory



In the cybersecurity node, BCAM contributes with the "*artificial intelligence and cybersecurity laboratory*", that offers solutions based on data analytics. The tools are devoted to tasks such as intrusion detection and, anomaly detection and predictive analysis among others. The team is composed of statisticians, computer scientists and mathematicians which have experience both at academia and industry in designing and implementing machine learning tools, statistics for large data volumes, information extraction and prediction.

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### INNOLAB Bilbao

<https://www.ilb.eus/en/>

INNOLAB is an innovation platform that connects businesses and technology in order to look for digital solutions to current business and social challenges. This platform is specialized in Artificial Intelligence and Data Analytics. BCAM is institutional member of this association since 2018.





**EARMA European Association of Research Managers and Administrators**

<https://www.earma.org/>

EARMA represents the community of Research Managers and Administrators in Europe and its mission is to support excellent research by supporting their members in their profession as RM&As. EARMA provides a networking forum, a learning platform, and a place to share experiences and best practice among RM&As throughout EARMA and in the wider RMA community. BCAM administrative staff members are part of EARMA so as to get experience on best practices that can be applied to the center management.

# 11.2.

## SOCIETIES

We are institutional members of the following societies:



### **EMS European Mathematical Society**

<https://euromathsoc.org>

The European Mathematical Society is a learned society representing mathematicians throughout Europe. It promotes the development of all aspects of mathematics in Europe, in particular mathematical research, relations of mathematics to society, relations to European institutions, and mathematical education.

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### **RSME Real Sociedad Matemática Española**

<https://www.rsme.es>

The Spanish Royal Mathematical Society is a learned society whose aim is the promotion and dissemination of Mathematics and its applications, and the encouragement of its research and teaching at all levels of education.

In 2019 – 2020 BCAM contributed to the “White paper on Mathematics” that was published in October 2020.

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# S $\vec{e}$ MA

**Sociedad Española  
de Matemática Aplicada**

### **SEMA Sociedad Española de Matemática Aplicada**

<https://www.sema.org.es/es/>

The Spanish Society of Applied Mathematics (SEMA) was created in 1991, as a milestone in the development of applied mathematics in Spain, motivated by the success and continuity of the national Spanish Congress of Differential Equations and their Applications (CEDYA), that began in 1978. Its main purpose was to contribute in a coordinated manner to the development of mathematics in connection with its applications, responding in this way to new challenging problems of the real world, in the most diverse areas in science and industry.

$(\Phi, \Psi)$

$M \in \mathbb{N}$  with  $M > 0$

$$\Omega_M = \{\theta_0, \theta_1, \dots, \theta_M\}$$

$P_M, Q_M = [-$

$$0 = \theta_0 > \theta_1 > \dots > \theta_{M-1} > \theta_M = -\tau$$

$$Y_M := \mathbb{R}^{\Omega_M / \{0\}} \cong \mathbb{R}^M$$

$$Z_M := \mathbb{R}^{\Omega_M} \cong \mathbb{R}^{M+1}$$

$$\Phi := (\Phi_1, \dots, \Phi_M) \in Y_M$$

$$\Psi = (\Psi_0, \Psi_1, \dots, \Psi_M) \in Z_M$$

$$\mathcal{D}_M \cong \mathcal{D}$$

$\Rightarrow$  The eigenvalues

$$\lambda \in \sigma(\mathcal{D})$$

$$\lambda_M \in \sigma(\mathcal{A}_M)$$

$$\lambda_M \rightarrow \lambda$$

# 11.3. AGREEMENTS

## 11.3.1. INTERNATIONAL AND NATIONAL AGREEMENTS

### SPAIN ●●●

- Universidade da Coruña
- Universitat de València
- Universidad Politécnica de Madrid

### SWEDEN ●

- KTH  
Computer Science and Communication

### FRANCE ●●●●

- Toulouse University
- Bordeaux University
- INRIA Sophia Antipolis Mediterranean
- ISAE  
Institut Supérieur de l'Aéronautique et de l'Espace

### UNITED KINGDOM ●●

- School of Mathematics  
Bristol University
- Cranfield University

### GERMANY ●

- Potsdam University

### ITALY ●

- ILLY CAFFÈ

### AUSTRIA ●

- SCCH  
Software Competence Center Hagenberg

### RUSSIA ●

- Ioffe Institute  
St. Petersburg

### USA ●●

- Computational Modeling Initiative, LLC
- UCLA University of California, Los Angeles

### SAUDI ARABIA ●

- KAUST  
King Abdullah University of Science and Technology

### INDIA ●

- University of Delhi, Cluster Innovation center

### CANADA ●

- Wilfrid Laurier University

### ARGENTINA ●

- YPF Argentina

### CHINA ●●

- College of Sciences  
Shanghai University
- Tsinghua University  
Electronic Engineering Department







BCAM &  
COVID-19

12.

## BCAM & COVID-19

BCAM as a research center in Applied Mathematics and therefore, in line with its social commitment and its mathematical/statistical modeling expertise, has worked actively with other experts to contribute the fight against coronavirus from Applied Mathematics.

Since the beginning of the health crisis, in March 2020, a working group called Basque Modeling Task Force (BMTF) was created to assist the Basque health managers and the Basque Government during the COVID-19 crisis. The group was set up within the framework of the Data Science, Artificial Intelligence and Mathematical and Theoretical Biology research lines at BCAM as well as the Basque Health Institutions which collaborate closely with the UPV/EHU and Ikerbasque. This group also contributed to the “Mathematical Action against COVID-19” promoted by CEMAT (<https://matematicas.uclm.es/cemat/covid19/en/>) and to other international calls to support the fight against COVID-19.

This multidisciplinary group is composed by internationally recognized scientists with extensive experience in modelling infectious disease dynamics such as influenza, dengue and vaccine preventable diseases as well as experts from other institutions with complementary scientific perspectives, providing information for decision-makers, as well as day to day support for hospitals in managing the health crisis.

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**01**  
**Epidemiological modelling** of the dynamics of COVID-19 to study the impact of the pandemic

**BCAM Project team:**  
- Maira Aguiar (BCAM-Ikerbasque)

**Collaborators:**  
- Nico Stollenwerk (University of Lisbon)  
- Department of Health of the Basque Government and Osakidetza

**02**  
**Statistical and operations research** techniques for estimating hospital admissions, infections and under reporting

..... [02.1] A Bayesian SEIR Model for predicting COVID-19 hospital admissions and infected cases in the Basque Country  
..... [02.2] Predicting the need for hospital beds and ICU by methods of simulation and operations research  
..... [02.3] Using a delay-adjusted case fatality ratio to estimate under-reporting

**BCAM Project team:**  
- Inma Arostegui (BCAM-UPV/EHU), Dae-Jin Lee, M. Xosé Rodríguez (BCAM-Ikerbasque) Moumita Das, Fernando Garcia, Joaquin Martinez, Abelardo Monsalve and Carlos J. Peña

**Collaborators:**  
01 - Department of Health of the Basque Government and Osakidetza  
02.1 - Quantitative Methods for Lifting the Performance of Health Service group (LIPNA)  
02.2 - Clinical Research Unit at the Galdakao-Usansolo Hospital

**03**  
**Machine Learning** approach for the prediction of hospitalizations and intensive care unit (ICU) admissions

**BCAM Project team:**  
- J.A. Lozano (BCAM-UPV/EHU) and Onintze Zaballa

**Collaborators:**  
- Department of Health of the Basque Government and Osakidetza

Through epidemiological models (SIR and extensions), operational research and Gaussian processes, it was possible to describe the dynamics of the disease. The results were validated with data on the incidence of confirmed cases of COVID-19 in the Basque Country, data on hospital stays, ICU and mortality provided by Osakidetza (Basque Health Service). In addition, work continued on evaluating the effect of the containment measures carried out on the transmission of the disease with the aim of supporting future decisions on its progressive flexibilization.

On May 2020, the Lehendakari, Iñigo Urkullu, and the Councilors for Education and Health, Cristina Uriarte and Nekane Murga, met the team from the Basque Centre for Applied Mathematics – BCAM, the University of the Basque Country (UPV/EHU), Ikerbasque and Basque health institutions. During the meeting, both the Lehendakari and the Councilors showed their gratitude to BCAM's research team, highlighting the contribution of scientific research of excellence to the health management of the pandemic in the Basque Country.

In view of the economic and social impact caused by the COVID-19 epidemic and the importance of the development of excellence research in mathematical modelling applied to health, BCAM is contributing to promoting the reinforcement of this group in the mid/long term. This group will contribute, focusing its fundamental research capacities, to strengthen the fight against other diseases and to contribute to recovery and to minimize possible future impacts. In this sense, BCAM is launching new research projects in the fields of advanced mathematical modelling applied to health in public health epidemiology, health services and precision medicine & personalized healthcare.





## COVID-19 AT BCAM

In the area of people management, in 2020, BCAM had to modify the working conditions to respond to the pandemic caused by COVID-19. In this regard, the employees have had to adapt and respond to the needs caused, with the aim of guaranteeing the well-being of the research staff and the correct development of the activity remotely.

To this end, different measures have been implemented that have been adapted according to the restrictions of the moment:

- Flexibility measures have been implemented, including flexible working hours and working from any location.
- Security measures in the workplace have been reinforced.
- Information has been provided on how to proceed in the event of symptoms, and how to report them both at work and in the personal sphere.
- Up-to -date information to researchers about Covid-19 restrictions.







Mazarredo 14, 48009 Bilbao  
Basque Country, Spain  
T: +34 946 567 842  
F: +34 946 567 843  
[info@bcamath.org](mailto:info@bcamath.org)  
[www.bcamath.org](http://www.bcamath.org)



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Basque Foundation for Science

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diputación foral

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de la innovación

  
**Petronor**  
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