

2021

Activity report

2021

Activity
Report



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Introduction

JOSÉ ANTONIO LOZANO

Scientific Director



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 centre 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.

While 2020 will be remembered as a year of the break out of COVID-19, our lives and particularly BCAM have continued affected for the pandemic during 2021. However, we have started to recover our before pandemic activities and, at the same time, have learnt the positive part of the lessons the pandemic has offered. We have sparked our imagination in order to learn how to work and collaborate remotely and part of these abilities will keep with us forever. Furthermore, we have continued supporting the institutions in combating the consequences of the pandemic 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 47. Most of these publications are in Q1 (79,6 %) and/or D1 (43,4 %) 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 63 researchers. While the pandemic still prohibited from having personal contact in most occasions we continued the relation with our collaborators virtually. As a consequence, we have been hardly working on our research projects (including a Future Emerging Technologies – FET project that BCAM leads), contributed to the Mathematics Laboratory for Trans-border Cooperation – Transmath, led the Spanish Network of Mathematics and launched the BCAM

International Strategic Research Labs Programme. 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.

ikerbasque
Basque Foundation for Science

innobasque
Berrikuntzaren Euskal Agentzia
Agencia Vasca de la Innovación

Universidad
del País Vasco

Euskal Herriko
Unibertsitatea

Petronor
Innovación

Bizkaia
Foru aldundia
diputación Foral



BCAM in numbers

Scientific outputs¹

- Number of indexed articles: **152**
- Q1: **79,61%**
- D1: **43,42%**
- H index: **47**
- **1479** selected documents are cited 3006 times in 2021 by 4111 documents

Funding

- Total annual funding: 5,9M€
 - Basque Country: 3,21M€
 - Spain: 1,6M€
 - Europe: 0,51M€
 - Private & other: 0,58M€

Grants in place

- **7** International public projects
 - **3** ERC
 - **1** FET
 - **4** Marie Skłodowska-Curie
 - **1** INTERREG POCTEFA
- **15** National public projects
- **18** Local public projects
- **6** Private projects

Training and knowledge transfer

- **5** defended Doctoral theses
- **57** ongoing Doctoral theses
- **25** ongoing Postdoctoral Trainees
- **9** ongoing Joint Positions

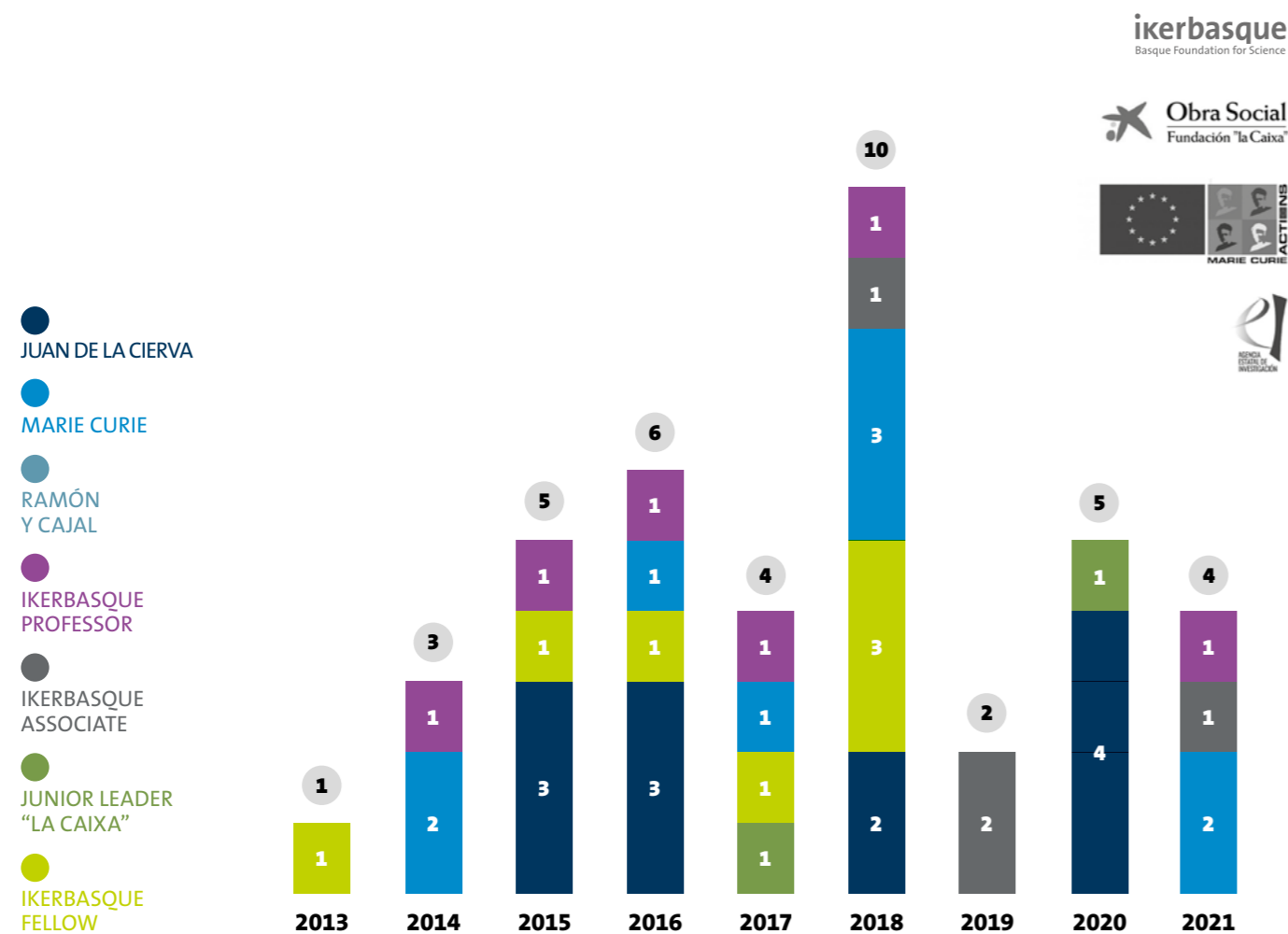
Personnel

- **140** research staff at December 31, 2021
- **13** administrative staff as of December 31, 2021
- **28%** women in BCAM in 2021
- **63** new researchers joined BCAM through the different calls
- **13** Visiting Fellows were received
- **37** people completed their internship at BCAM
- **17** visitors were received

¹ Year range: 2021. Data source: Scopus. Date exported: 21/02/22 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.

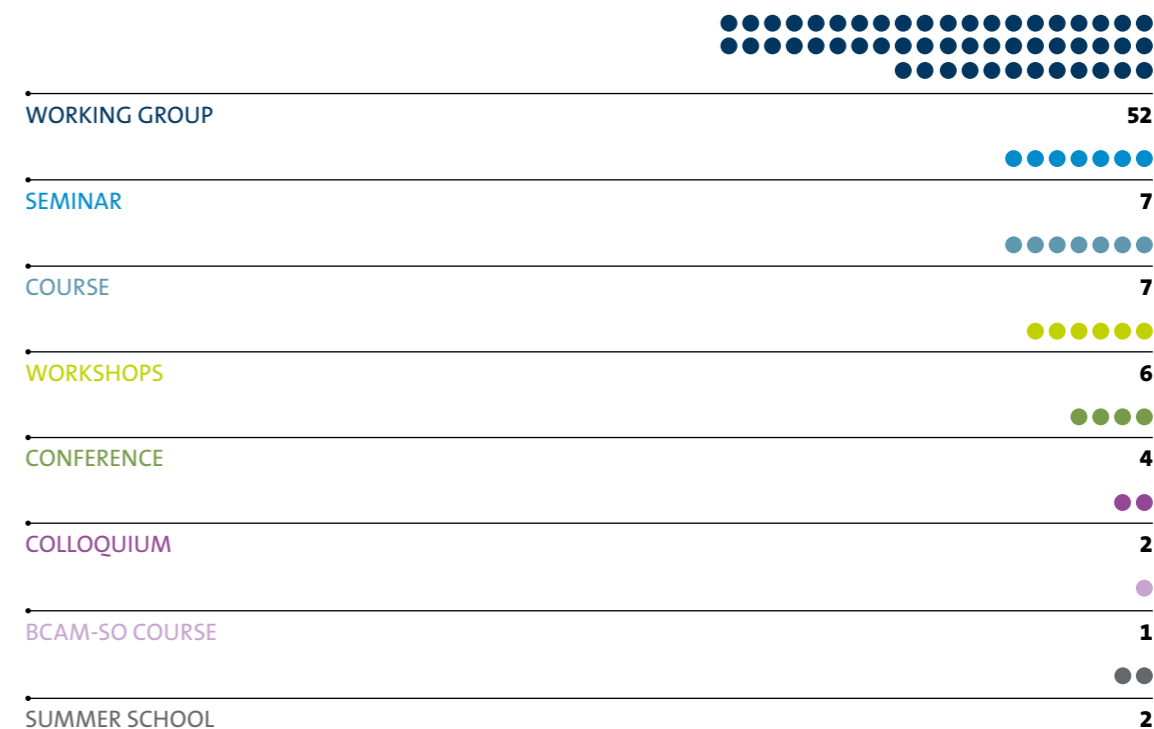
An index to quantify an individual's scientific research output. Proc Natl Acad Sci U S A. 2005 November 15; 102(46): 16569–16572. doi: 10.1073/pnas.0507655102.

Competitive individual grants



- **63** researchers have been incorporated during 2021 in the different BCAM calls
- BCAM has received **17** visitors, **13** visiting fellows and **37** internships
- **1** 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



Social media

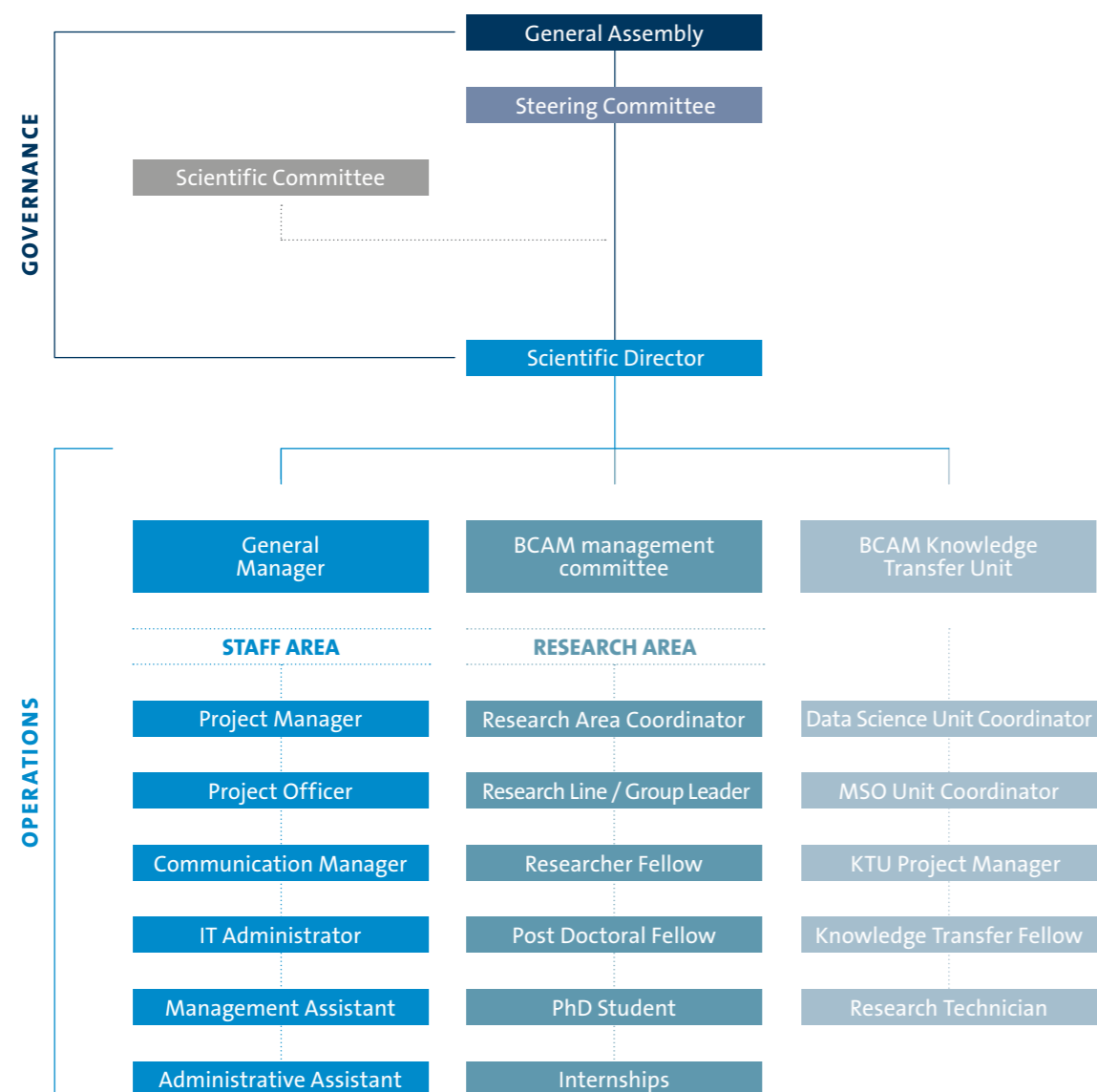
TWITTER	FOLLOWERS	1716	IMPRESSIONS	528900
LINKEDIN	FOLLOWERS	1431	IMPRESSIONS	64196
YOUTUBE	FOLLOWERS	155	IMPRESSIONS	19200

Data source:
Twitter, LinkedIn
and Youtube.

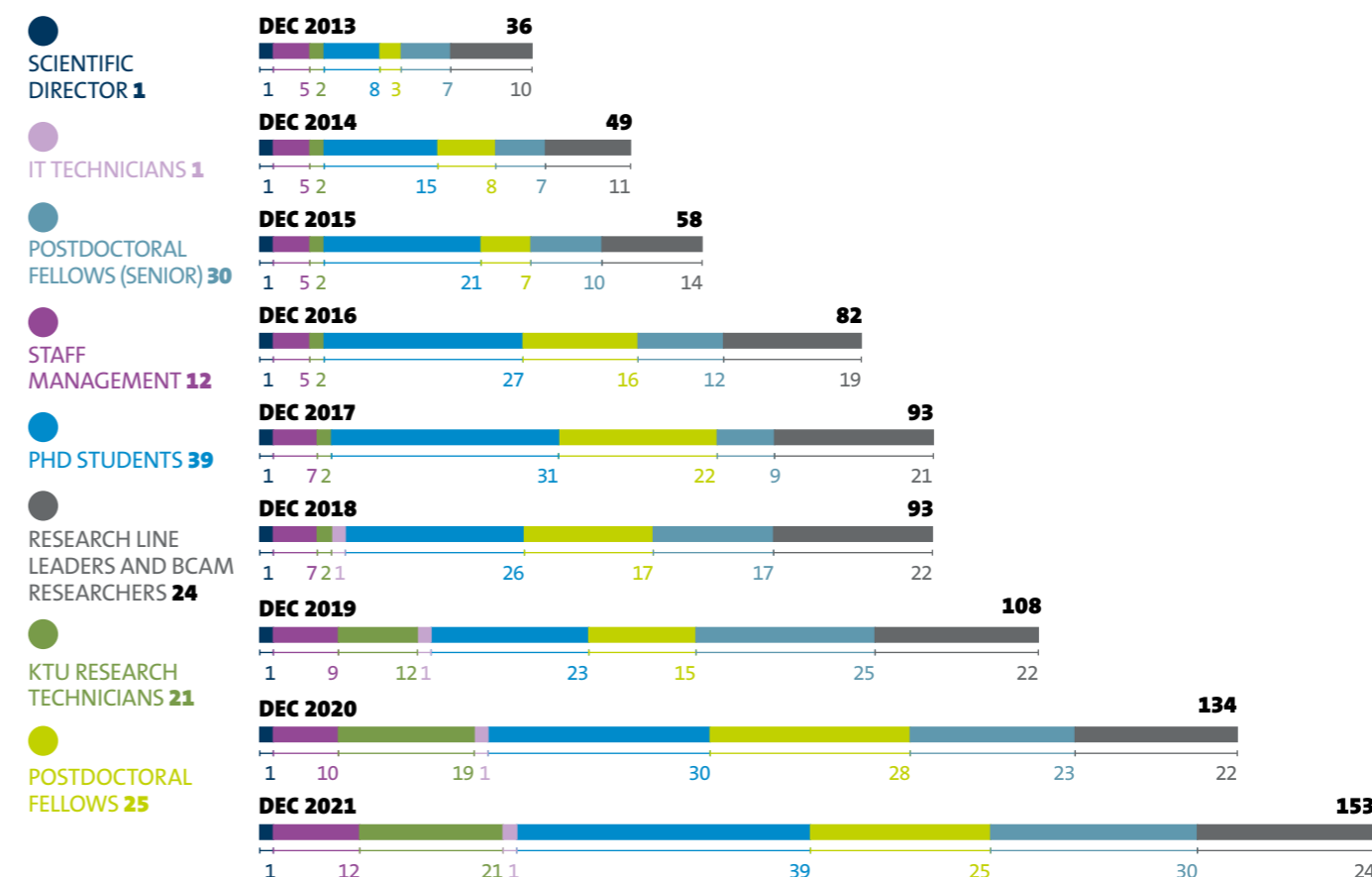
Data exported:
31/12/2021.

People

BCAM's organization chart is as follows:



Below is the evolution of personnel at the centre in the period 2014-2021



Moreover, during 2021:

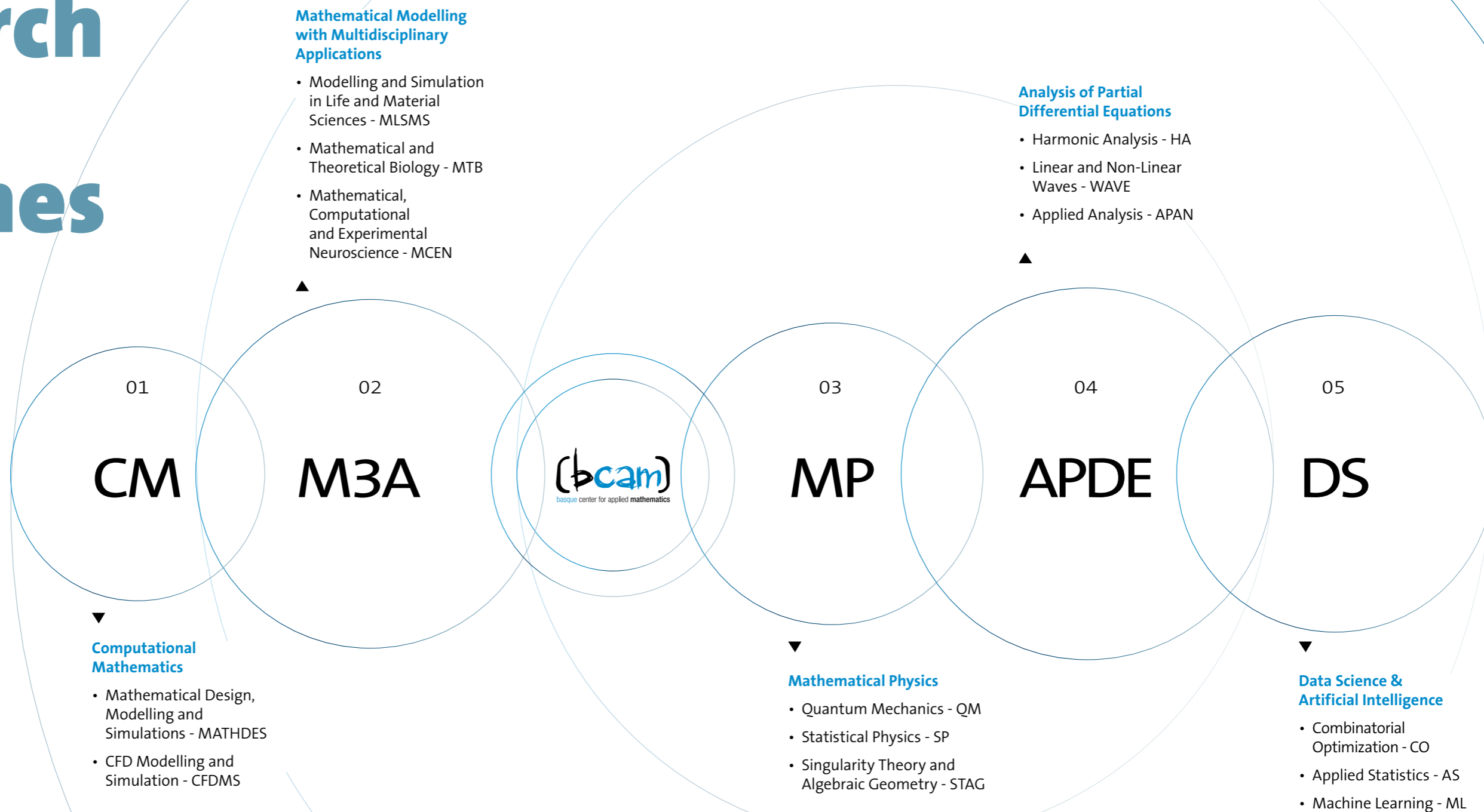
- 5 doctoral theses have been defended with BCAM affiliation and whose thesis supervisors are affiliated to the centre
- 13 Visiting Fellows were received
- 17 Visitors were received
- 35 people completed their internship at BCAM
- 63 new researchers have joined BCAM through the different calls

3.1

Research areas and lines

In 2021, 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.

3.1.1.

BCAM research staff in 2021



SCIENTIFIC DIRECTOR

Lozano, José Antonio

UPV/EHU Professor & BCAM

RESEARCH AREA RESEARCH LINES

DS ML

PROFESSORS

RESEARCH AREA RESEARCH GROUP

Akhmatskaya, Elena	<i>Ikerbasque Professor at BCAM</i>	M3A	MSLMS
Bru, Jean-Bernard	<i>Ikerbasque Professor at BCAM UPV/EHU</i>	MP	QM
Coello, Carlos A.	<i>Ikerbasque Professor at BCAM</i>	DS	CO
Ellero, Marco	<i>Ikerbasque Professor at BCAM</i>	CM	CFDMS
Fernandez de Bobadilla, Javier	<i>Ikerbasque Professor at BCAM</i>	MP	STAG
Pardo, David	<i>Ikerbasque Professor at BCAM UPV/EHU</i>	CM	MATHDES
Pérez, Carlos	<i>Ikerbasque Professor at BCAM UPV/EHU</i>	APDE	HA
Rodrigues, Serafim	<i>Ikerbasque Professor at BCAM</i>	M3A	MCEN
Vega, Luis	<i>UPV/EHU Professor & BCAM</i>	APDE	WAVE
Zarnescu, Arghir Dani	<i>Ikerbasque Professor at BCAM UPV/EHU</i>	APDE	APAN
Arostegui, Inmaculada	<i>UPV/EHU Professor linked to BCAM</i>	DS	AS
Murua, Ander	<i>UPV/EHU Professor linked to BCAM</i>	CM	MATHDES



3.1.1.

ASSOCIATE & FELLOW RESEARCHERS		RESEARCH AREA	RESEARCH GROUP
Aguiar, Maíra	<i>Ikerbasque Research Fellow & Research Line Leader</i>	M3A	MTB
Bartoň, Michael	<i>Ikerbasque Research Associate & Ramon y Cajal Fellow</i>	CM	MATHDES
Lee, Dae-Jin	<i>BCAM Researcher & Research Line Leader</i>	DS	AS
Lucà, Renato	<i>Ikerbasque Research Fellow</i>	APDE	WAVE
Mazuelas, Santiago	<i>Ikerbasque Research & Ramon y Cajal Fellow</i>	DS	ML
Nava, Vincenzo	<i>BCAM Researcher</i>	CM	CFDMS
Quadrianto, Novi	<i>BCAM Researcher</i>	DS	ML
Pagnini, Gianni	<i>Ikerbasque Research Associate & Research Line Leader</i>	MP	SP
Perez, Pedro	<i>Ikerbasque Research Associate</i>	APDE	HA
Roncal, Luz	<i>Ikerbasque Research & Ramon y Cajal Fellow</i>	APDE	HA
Smirnov, I.	<i>Ikerbasque Research Fellow & Junior Leader</i>	MP	STAG

POSTDOCTORAL FELLOWS	RESEARCH AREA	RESEARCH GROUP
Abedi, Mohammad Mahdi	CM	MATHDES
Acharya, Sayantan	MP	SP
Bakas, Odysseas	APDE	HA
Balboa, Florencio	CM	CFDMS
Barros de Souza, Danilo	M3A	MCEN
Ciampa, Gennaro	APDE	HA
Costa de Sousa, Mateus	APDE	HA
Cusimano, Nicole	M3A	MTB
Dempsey, Róisín Mary	M3A	MCEN
Earls, Ashley Nicole	M3A	MCEN
Eberle, Simon Andreas	APDE	WAVE
Estrada, Gissell	M3A	MSLMS
García, María Ángeles	APDE	WAVE
García, Fernando	DS	AS
Garreta, Albert	MP	STAG
Geng, Zhiyuan	APDE	APAN
Gidituri, Harinadha	CM	CFDMS
Gordaliza, Paula	DS	AS
Hashemian, Ali	CM	MATHDES
Hernández, Dariel	CM	CFDMS
Iakunin, Sergei	APDE	WAVE
Inouzhe, Hristo	DS	AS
Knopoff, Damian Alejandro	M3A	MTB
Kosz, Dariusz Mirosław	APDE	HA
Mishra, Sarvesh Kumar	CM	MATHDES
Mo, Chaojie	CM	CFDMS
Moragues, Margarida	CM	CFDCT
Moreno, Nicolas	CM	CFDMS

3.1.1.

POSTDOCTORAL FELLOWS	RESEARCH AREA	RESEARCH GROUP
Muñoz, Judit	CM	MATHDES
Nguyen, Xuan Viet Nhan	MP	STAG
Nieraeth, Zoe	APDE	HA
Nieto, David	CM	CFDMS
Pelka, Tomasz Ryszard	MP	STAG
Pérez, Aritz	CM	ML
Pohjola, Carl Valter	APDE	HA
Ponce, Felipe Eduardo	APDE	HA
Rincón, Mauricio	M3A	MSLMS
Rochera, David	CM	MATHDES
Rojas-Delgado, Jairo	DS	ML
Rossi, Emanuele	CM	CFDMS
Roy, Arnab	APDE	APAN
Rusconi, Simone	CM	MSLMS
Schenk, Christina	M3A	MSLMS
Senhaji, Kaoutar	DS	CO
Shirazi, Abolfazl	DS	ML
Sliusarenko, Oleksii	CM	MATHDES
Smyrnelis, Panayotis Alexandros	APDE	AA
Souto Maior Mendes, Caetano	DS	AS
Steindorf, Vanessa	M3A	MTB
Stollenwerk, Nico	M3A	MTB
Szarek, Tomasz Zachary	APDE	HA
Taylor, Jamie Michael	APDE	APAN
Zalcer, Sylvain Ezechiel Jerome	MP	QM
Zohravi, Elnazossadat	CM	CFDMS

PHD STUDENTS	RESEARCH AREA	RESEARCH GROUP
Aldasoro, Marta	MP	STAG
Alonso, Ioseba Iñaki	DS	ML
Álvarez, Verónica	DS	ML
Anam, Vizda	M3A	MTB
Arza, Etor	DS	ML
Barrainkua, Ainhize	DS	ML
Berggren, Karl Henrik Teodor	M3A	MCEN
Bidaurrezaga, Arkaitz	DS	ML
Bonifazi, Giulio	M3A	MCEN
Camarasa, Miguel	APDE	WAVE
Cañizares, Manuel	APDE	HA
Caro, Felipe Vinicio	CM	MATHDES
Ceuca, Razvan-Dumitru	APDE	APAN
Dahlenburg, Marcus	MP	SP
Dancheva, Tamara	CM	MATHDES
de la Bodega, Javier	MP	STAG
Echeverría, Marina	M3A	MTB
Espinosa, Juan Carlos	DS	AS
Estadilla, Carlo Delfin Silverio	M3A	MTB
Florez, Mikel	APDE	HA
Gago, Imanol	DS	CO
Galán, Cristina	DS	AS
Garcia, Ander	CM	CFDMS
Gardeazabal, Iker	APDE	HA
Girier, Guillaume	M3A	MCEN
González, Jesús	CM	CFDMS
Gorostidi, Nicolás	CM	MATHDES

3.1.1.

PHD STUDENTS	RESEARCH AREA	RESEARCH GROUP
Hernández, Maria Alejandra	DS	AS
Lill, Sascha	MP	QM
Martinez, Mario	DS	ML
Nagar, Lorenzo	M3A	MSLMS
Parga, Martín	M3A	MSLMS
Pérez, Diana Marcela	DS	AS
Rajain, Kanika	CM	MATHDES
Rodrigues, Kauê	MP	QM
Rodríguez, Oscar Alberto	CM	MATHDES
Segovia, José Ignacio	DS	ML
Uriarte, Carlos	CM	MATHDES
Zumeta, Lore	DS	AS

RESEARCH TECHNICIANS	RESEARCH AREA	RESEARCH GROUP
Barreñada, Lasai Alai	DS	ML
Bondugula, Kartheek Reddy	DS	ML
Boujaada, Ahmed	DS	ML
Casado, Ioar	DS	ML
Claros Alejandro	APDE	HA
Cortes, Henry Andres	M3A	MSLMS
Danielewicz, Joanna	M3A	MCEN
García de Beristain, Imanol	CM	CFDMS
Gonzalez, Eki	MP	STAG
Guerrero, Bruno Valdemar	M3A	MTB
Guerrero, Claudia	DS	ML
López De Castro, Marcos	MP	SP
Merino, Pablo	DS	ML
Métraud, Nathan Jean Hippolite	MP	QM
Monsalve, Abelardo Enrique	DS	AS
Moreno, Daniela	CM	CFDMS
Olza, Alexander	DS	AS
Srivastav, Akhil Kumar	M3A	MTB
Strugaru, Magdalena	CM	MATHDES
Tahat, Amani	DS	AS
Uranga, Anton	DS	AS

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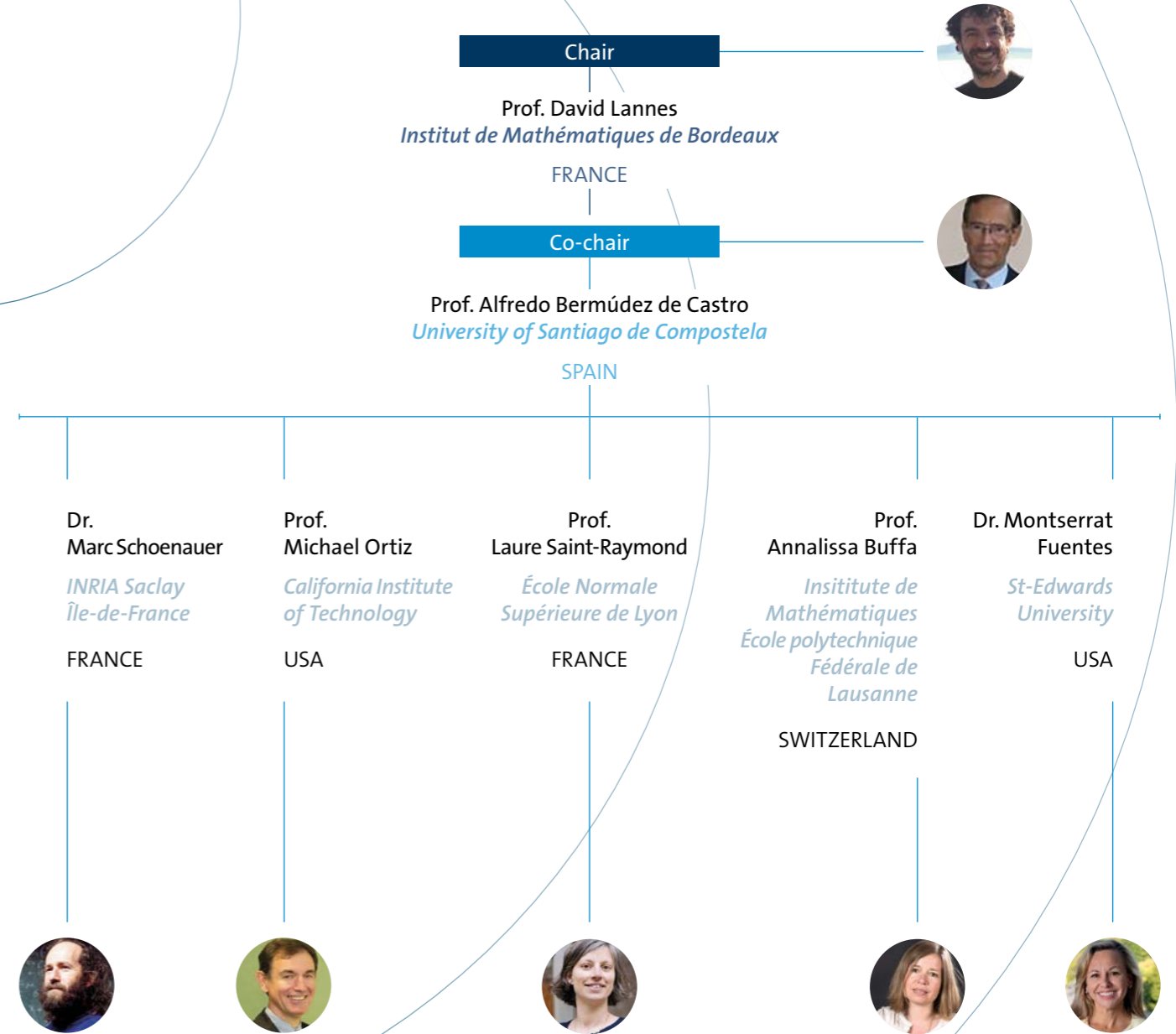
3.2.

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 centre's strategic plan, provide advice on different topics and validate the results obtained. The composition in 2021 is as follows:



3.3.

Administrative staff

Benítez, Miguel A.	Project Manager
Eguiluz, Begoña	Management Assistant
Elespe, Irantzu	Management Assistant
Fuentes, June	Internship
Gómez, Lorea	General Manager
González, Ainara	Project Manager
Gutiérrez, Estibaliz	Communication Technician
Hernández, Olatz	Communication Manager
Hernández Idoia	Management Assistant
Hurtado, Agurtzane	Administrative Assistant
Mena, Nerea	Project Officer
Onaindia, Aitor	IT Manager
Sojo, Asier	Management Assistant



3.4.

Women at BCAM

Luz Roncal

Ikerbasque Research and
Ramón Cajal Fellow

I am Ikerbasque Research Fellow since 2019 at BCAM, where I arrived in 2016. I belong to the group of Analysis and Partial Differential Equations, within the research line in Harmonic Analysis. In 2020 I obtained a Ramón y Cajal Fellowship. I am also Research Collaborator at the Department of Mathematics of the University of the Basque Country.

I got my PhD in 2009 at the University of La Rioja, where I was working as Titular de Universidad Interina between 2010 and 2016.

In 2017 I obtained a grant Leonardo from the BBVA foundation, devoted to support researchers and cultural creators with a highly innovative scientific, technological or cultural productivity. In 2019 I was awarded the Prize to the Young Female Scientific Talent, delivered by the Foundation of the Academy of Sciences of Spain (FRACE) and Mastercard. I am a member of the Governing Board of the Spanish Royal Mathematical Society since 2022.

When I began the PhD studies I did not have a clear and strong conviction that my life was going to be devoted to research in Mathematics. On the contrary, I moved to the high school when I had not even completed the PhD.

But life is life; several circumstances put me back in the academy and I resumed the research path.

It could be said that my career is a sort of counterexample of what a standard research career, say PhD-postdoc(s)-position at the university, should look like. Nevertheless, I found that my passion for mathematics and research were growing and growing and I realized that this is the work I really wanted to do.

The moral is that my research career is a path of effort, work, and perseverance. The thrill for broadening my knowledge and for fighting with challenging problems overcame the obstacles and difficulties of being an “outsider”. In the end, I am very happy to follow the path I chose, I have the feeling that I am doing what I really like.

If I had to transmit a message to younger researchers, I would tell them to do what they really love, with passion and conviction. The way is hard, one will fall so many times and will feel discouraged. My advice to the youngest is to keep pushing, look ahead and never surrender.

I am an applied mathematician and my main research interests are in the development and application of mathematical and computational methods for complex biological systems, solving real-life problems by merging theoretical results with observational and experimental data. I graduated in mathematics at the University of Trieste, Italy, in 2010 and moved to Australia for what I thought was going to be a 1-year masters course overseas. I fell in love with the place, the people, and my work, my masters became a PhD and, after obtaining my doctorate in applied mathematics at the Queensland University of Technology, Brisbane, in 2015, I worked for a year as postdoc at the ARC Centre of Excellence for Mathematical and Statistical Frontiers in the same city. In 2016 I came back to Europe, moved to Bilbao, and started my career at BCAM where to this day I hold a postdoctoral position in the research area “Mathematical Models with Multidisciplinary Applications”.

Throughout the years I have had the chance to meet in person many female scientists at various stages of life and their professional career and of all these women in the STEM world, the ones that I admire the most are the ones who are mothers as well. While there are undeniable

challenges for all genders in merging a professional scientific career with their personal life, I really believe that women have it particularly hard. If there is a category in the STEM world that truly is my biggest inspiration, that would be the one of women scientists who are mothers, who have put incredible amounts of energy and time in their research while also being able to raise beautifully happy children, and who seem so effortlessly able to be absolutely great at everything they do.

To the young researchers I would say, pursuing research as a professional career involves a lot more than doing the research itself. Learn how the system works as soon as you can, ask a lot of questions, don't be afraid to reach out and talk to more experienced researchers about their professional path and choices. Plan. I know that planning might be a daunting task when you are still trying to figure out what you want to do with your future, but you need to know what are the challenges that you are likely to face in this field and plan how to deal with them, if you want to be a researcher. And plans can obviously change later on. That's ok. Keep an open mind and take a deep breath. You can do it!

Nicole Cusimano

Postdoctoral Fellow





Tamara Dancheva
PhD Student

My path to becoming a researcher in applied mathematics and mechanical engineering has been anything but calculated. In primary school, I liked maths, but I was much more passionate about literature. By the time I reached university, I had become very interested in computer science and everything related. I decided to study computer science and engineering at the local university in Skopje, North Macedonia, which had just opened an independent faculty for computer science, and I became part of its first generation of students. In the last year of my bachelor's, I took a course on Scientific computing with concrete applications in biomedicine that completely turned my life around. I went back to exploring partial differential equations, mathematical modelling, and physics in much more detail. I saw an infinity of possibilities in the intersection of scientific programming and natural sciences. I enrolled in a Master of Computational Mechanics at the University of Strasbourg, diving into mathematics and physics with applications in many other fields, such as the mechanics of solids, fluids, hydrology, and geomechanics (the distribution and movement of groundwater in the soil). Today I specialize in high-performance computing for computational mechanics.

While there is still work to be done everywhere on strengthening the economic role of women in society, now I realize that I have had the enormous privilege to be taught STEM subjects by mostly female professors in my home country. They have been my role models, and I am especially thankful to my Maths teacher in primary school for the extra math lessons she gave me to prepare me for competitions and instilled in me a love for mathematics. Along with the unconditional support from my family and friends for all my endeavours, they all made me believe that I can choose any career I want.

With time, I have learned to accept uncertainty can be a good thing in a world that is transforming at a faster and faster pace. Changes and a wealth of resources available at hand lead to more and more opportunities to achieve your goals and reinvent yourself. To all those passionate about research, don't be afraid to try. Don't be afraid to fail.

My name is Cristina Galán García-Arcicollar and I am a mathematician. I have always been interested in science subjects as a child, but it wasn't until high school that one of my teachers suggested I study mathematics. Then that idea came to my mind, and I ended up enrolling in a mathematics degree at the Autónoma University of Madrid. I wanted to keep studying mathematics and I got a master's in Advanced Mathematics and Applications, so I could keep the option of going on for a PhD. I did an internship in the Big Data sector of a private company because of my doubts, but finally I decided to get into a doctoral program and I am currently pursuing my PhD in the Applied Statistics research group at BCAM.

I was encouraged and supported by different women from the STEM world when I decided to continue my academic career. I would like to recognize all the women who dedicate time to sharing their experiences and offering advice to girls at various stages of their educational journeys through mentoring or talks. In this way, they make STEM more accessible to more women and make them aware of the significant role women play, thus reducing inequality and

promoting inclusion. Lastly, I would like to emphasize to girls who are interested in scientific research that it is important to understand the barriers imposed by society due to its devaluing views of women. Knowing these obstacles allows us to overcome them and achieve our goals. As a result, the world will keep changing and barriers will become smaller for future generations.

Cristina Galán
PhD Student





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: 2015/12 - 2021/11

PI: **Prof. Vega, L.**

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 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.

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.

About the PI

Vega, L. 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, the Spanish Real Academia de Ciencias and has been awarded Premio Nacional Julio Rey Pastor in 2021. 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: 2020/01 - 2023/12

PI: **Dr. Bartoň, M.**

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: 2018/02 - 2022/01

Principal Investigator: **Dr. Bartoň, M.**

The ENABLE is an ETN (European Training Network) project that aims to train earlystage 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 (publicprivate 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

Bartoň, M. 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.



77778

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: 2018/04 - 2023/03

PI: **Dr. Hashemian, A.**

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 CO2 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.

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 CO2

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. We will also show the progress of our work to other European-based oil companies, and mining companies.

About the PI

Hashemian, A. 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 Turbomachin.

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: 2020/11 - 2024/10

PI: **Dr. de Pitta, M.**

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

De Pitta, M. 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: 2019/12 - 2021/11

Marie Curie Fellow: Smyrnelis, P.

Advisor: Prof. Zarnescu, A.

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 quantum computation, telecommunications, and astronomy (improvement of images, detection of exoplanets).

About the Marie Curie Fellow

Smyrnelis, P. 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: 2020/09 - 2023/08

Marie Curie Fellow: Dr. Moragues, M.

Advisors: Prof. Sherwin, S and Dr. Marras, S.

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 Marie Curie Fellow

Moragues, M. is a Marie Skłodowska-Curie Action Individual Fellowship (MSCAIF- 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 Design of a Virtual Blood Rheometer for Thrombotic Process Characterization (H2020)

Funded by: MSCA-IF-SF-2020: Marie Skłodowska-Curie
Duration: 2022/01 - 2023/12
Marie Curie Fellow: Dr. Moreno, N.
Advisor: Prof. Ellero, M.

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 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.

About the Marie Curie Fellow

Moreno, N. 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: 2022/01 - 2024/12
Marie Curie Fellow: Muñoz, J.
Advisors: Prof. Demkowicz, L. and Prof. Pardo, D.

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 CO2 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 Marie Curie Fellow

Muñoz, J, 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. Demkowicz, L.



Early Prognosis of COVID-19 Infections via Machine Learning

Funded by: Axa Research Fund

Duration: 2020/10 - 2023/09

PI: Dr. Mazuelas, S.

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.

About the PI

Mazuelas, S. 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: 2019/09 - 2022/04

PI: Prof. Pardo, D.

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 beyondstate-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

Pardo, D. 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.



Artificial Intelligence for Sustainable Energy Transition (IA4TES)

Funded by: Artificial Intelligence R&D Missions Programme (Spanish Ministry of Economic Affairs and Digital Transformation)

Duration: 2022/01 - 2024/10

PI: Prof. Mazuelas, S. and Dr. Nava, V.

The ambition of the proposal includes research into the solutions that can be provided by the various Artificial Intelligence technologies, in the foreseeable development in the next three years, to the electricity sector, considering the new electricity system paradigm, with a mostly renewable production, a mix of centralised and distributed; with a digitised and automated, optimised grid, capable of providing bidirectional services to all types of users and interlocutors; with new services that facilitate the participation of users autonomously in the new electricity consumption models; and with an optimised design of the different markets and new advanced intelligence algorithms, such as in the new go-live paradigms.

The Commission's proposal for a new energy policy is a step in the right direction, and therefore, the sustainability of the energy model.

The project is organised in two dimensions: on the one hand, research on enabling technologies based on Artificial Intelligence, both in the new advanced intelligence algorithms and in new paradigms of data governance and distributed data intelligence. On the other hand, the use cases of application of these technologies to the four areas described above. Three types of partners have been considered for the development of the project: on the one hand, two large national companies, two large national companies, two large national companies, two large national companies

and two large national companies. Two large leading national companies, with wide international projection, in their respective sectors, such as Iberdrola in the energy area and Indra-Minsait in the area of digitalisation, with the aim of area of digitalisation, with a speciality area in Artificial Intelligence; on the other hand, 11 SMEs with very relevant previous experience in AI, in the energy sector or in other sectors but whose developments can be exported and with a research roadmap in the different technologies identified. The last type of partner will be made up of research organisations with advanced programmes and national and international benchmarks in the field of AI, both public and private, including 4 research centres and 3 public universities.

About the PIs

Mazuelas, S. 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.

Nava, V. received his B.Sc. and M.Sc. degrees in Civil Engineering from the Mediterranean University of Reggio Calabria (Italy). In 2009 he obtained a PhD in Maritime Engineering at the same university in collaboration with Rice University (Houston, USA). He also worked on a research project with BP America (Houston, USA) and as a lecturer and postdoctoral researcher at the Mediterranean University of Reggio Calabria (Italy) and at the Instituto Superior Técnico in Lisbon, Portugal. In 2013 he joined Tecnalia, first as a Marie Skłodowska-Curie fellow and then as a Senior Researcher, and since 2017 he has been working as a researcher in the field of offshore renewable energies at the Basque Center for Applied Mathematics (BCAM) and Tecnalia.



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
- Duration: 2015/12 - 2021/11
- PI: Vega, L.
- Beneficiaries: Universidad del País Vasco (UPV/EHU), Third parties: BCAM

STARTING GRANTS

- Call: ERCEA - Starting Grants 2019
- Project: 851538 - BayesianGDPR (H2020) – Bayesian Models and Algorithms for Fairness and Transparency
- Duration: 2021/03 - 2025/03
- PI: Quadrianto, N.
- Beneficiaries: University of Sussex, BCAM
- Call: ERCEA - Starting Grants 2020
- Project: 948029 - StableIF (H2020) – Stable interfaces: phase transitions, minimal surfaces, and free boundaries
- Duration: 2021/09 - 2025/12
- PI: Serra, J.
- Beneficiaries: ETHZ, BCAM

4.1.1.2.
FET OPEN

- FETOPEN-01 2019
- Project: 862025 - ADAM² (H2020) - Analysis, Design, And Manufacturing using Microstructures.
- Funding: 356.740€
- Consortium: BCAM, Israel Institute of Technology (TECHNION), École Polytechnique Federale de Lausanne (EPFL), Universidad del País Vasco (UPV/EHU), Institut National de Recherche en Informatique et Automatique (INRIA), Technische Universität Wien (TUW), TRIMEK SA, STRATASYS LTD, HUTCHINSON SA, Seoul National University (SNU)
- Duration: 2020/01 - 2023/12
- PI: Bartoň, M.

4.1.1.3.
MARIE SKŁODOWSKA-CURIE ACTIONS

RESEARCH NETWORKS (ITN) INNOVATE TRAINING NETWORKS:

- Call: H2020-MSCA-ITN-2017
- Project: 764979 – ENABLE – European Network for Alloys Behaviour Law Enhancement
- Funding: 247.873€
- Consortium: Université de Bordeaux, Mines ParisTech, École Nationale d'Ingénieurs de Tarbes ENIT), Luleå University of Technology, Universidad del País Vasco (UPV/EHU), Tecnalia, Safran, SIRRIS
- Duration: 2018/02 - 2022/01
- PI: Bartoň, M.
- Call: H2020-MSCA-ITN 2020
- Project: 956325 - ASTROTECH (H2020) – Disruptive materials, technologies & approaches to unravel the role of Astrocytes in brain function and dysfunction: towards to Glial interfaces
- Funding: 250.905€
- Consortium: The Chancellor Masters and Scholars of the University of Cambridge (UCAM), Ustav Experimentální Medicíny Akademie Ved České Republiky Verejné Vědecké Ústavy (UEM AVCR), Université D'Aix Marseille (AMU), Centre National De La Recherche Scientifique (CNRS), Istituto Nacional de Engenharia Biomedica (INEB), Universidad Degli Studio di Bari Aldo Moro (UNIBA), Fondazione Istituto Italiano di Tecnologia (IIT), Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC), Avanzare Innovacion Tecnologica (AVA), Optoceutics APS
- Duration: 2020/11 - 2024/10
- PI: de Pitta, M.

4.1.

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: 202.500€ (BCAM)
- 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: 2018/04 - 2023/03
- PI: Hasebian, A.

4.1.1.4.
INTERREG POCTEFA

- Call: 3ª
- Project: EFA212/16 PIXIL – Pyrenees Imagining eXperience: an International network
- Funding: 117.000€
- Consortium: Barcelona Supercomputing Center (BSC), Universitat de Barcelona, Institut National de Recherche en Informatique et en Automatique (INRIA), RealTimeSeismic, Pole Avenia
- Duration: 2019/09 - 2022/04
- PI: Pardo, D.

4.1.2.

SPANISH STATE RESEARCH AGENCY

4.1.2.1.
EXCELLENCE ACREDITATION “SEVERO OCHOA”

- Centre of Excellence "Severo Ochoa" SEV-2017-0718
- Duration: 2018/06 - 2022/06
- Funded by: Spanish Government - AEI
- PI: Vega, L.
- Budget: 4.000.000€

4.1.2.2. NATIONAL PLAN R&D 2017-2021



CALL	PROJECT	FUNDING	DURATION	PI
Projects R&D&i G. Conocimiento 2020	PID2020-114750GB-C33 Singularities in Algebraic Geometry and their interactions with Topology, Metric Geometry and Symplectic Geometry.	49.368€	2021/09 - 2024/05	Fdez. de Bobadilla, J.
Projects R&D&i Challenges 2020	PID2020-115882RB-I00 New proposals for estimation, prediction and validation of semi-parametric models for the analysis of complex data with applications in Health and Climate Change	38.115€	2021/09 - 2024/10	Lee, D.
	PID2020-117080RB-C55 Microscopic foundations of soft-matter experiments: computational nano-hydrodynamics	84.700€	2021/09 - 2024/08	Ellero, M.
	PID2020-113156GB-I00 Harmonic Analysis and PDEs	61.710€	2021/09 - 2024/08	Roncal, L., Pérez, C.
	PID2020-114189RB-I00 Liquid Crystals and interactions	22.869€	2021/09 - 2024/08	Zarnescu, A.
Projects R&D&i Challenges 2019	PID2019-108111RB-I00 Real-time Inversion using Deep Learning Methods	136.004€	2020/06 - 2024/05	Pardo, D., Nava, V.
	PID2019-107685RB-I00 Ensemble forecasting for predicting wildfire propagation	46.343€	2020/06 - 2023/05	Pagnini, G.
	PID2019-104488RB-I00 Manufacturing of curved objects via Path-design of custom-shaped tools	136.004€	2020/06 - 2023/05	Bartoñ, M., Calleja, A.
Call: Projects R&D - G	PID2019-104927GB-C22 Geometric numerical integrators for quantum problems, celestial mechanics and monte carlo	64.977€	2020/06 - 2023/05	Akhmatskaya, E., Murua, A.
Conocimiento 2019	PID2019-105058GA-I00 Unifying data processing via probabilistic transformations	40.656€	2020/06 - 2023/05	Mazuelas, S.
Projects R&D&i - G. Conocimiento 2018	PGC2018-094522-B-I00 Mathematical and numerical analysis of some partial differential equations and their applications	142.780€	2019/01 - 2021/12	Vega, L., Cuesta, C.
Projects R&D&i Challenges 2018	PGC2018-094528-B-I00 Interplays between Harmonic Analysis and Inverse Problems	57.717€	2019/01 - 2021/12	Caro, P., Parissis, I.
	RTI2018-094595-B-I00 Virtual Rheological Analysis of Complex Shear Thickening Fluids	41.140€	2019/01 - 2021/06	Ellero, M.
Projects R&D&i Challenges 2017	MTM2017-82184-R Designed fluids: ferrofluids and beyond	34.969€	2018/01 - 2021/09	Zarnescu, A.
	TIN2017-82626-R Efficient Management of the Electric Energy Consumption by Means of the Classification, Prediction and Clustering of Time Series	68.002€	2018/01 - 2021/09	Pérez, A.
	MTM2017-82379-R New contributions in semiparametric regression and applications in agricultural field trials, epidemiological risks assessment and marine ecology	38.841€	2018/01 - 2021/06	Rodríguez, MX., Lee, D.
Scientific equipment for research	EQC2019-005376-P NEUROMATH LAB	111.224€	2020/01 - 2021/12	Rodriguez, S.
	RTI2018-093860-B-C21 Development of novel mathematical and experimental methodologies to control neuronal activity and dissect spatio-temporal neuronal codes	35.332€	2019/01 - 2021/12	Rodriguez, S.

4.1.

4.1.3. BASQUE COUNTRY



4.1.3.1. BERC PROGRAMME 2018-2021

- Duration: 2018/01 - 2021/12
- Funded by: Basque Government
- PI: Lozano, JA.
- Budget: 4.780.204€

4.1.3.2. ELKARTEK



PROJECT	FUNDING	DURATION	PI
KK-2020/00008 bG2020 - Precise medicine in cancer: Development of diagnostic tools and new therapies	94.185€	2020/03 - 2021/12	Akhmatskaya, E.
KK-2020/00050 TWIN-NET - Digital twin of the electricity distribution network to maximise renewable energy integration	102.690€	2020/03 - 2021/12	Mazuelas, S.
KK-2020/00016 CIRCU-AL - Circular economy of metal resources (application to aluminium alloys)	95.504€	2020/03 - 2021/12	Ellero, M.
KK-2020/00102 COPTER - Metrology applicable to highly complex geometries for ultra-precision transmissions	70.217€	2020/03 - 2021/12	Bartoñ, M.
KK-2020/00054 TRUSTIND - Creating Trust in the Industrial Digital Transformation	101.287€	2020/07 - 2021/12	Rojas-Delgado, J.
KK-2020/00049 3KIA - Integral and Transversal Proposal for the Design and Implementation of Reliable Systems based on Artificial Intelligence.	134.132 €	2020/03 - 2021/12	Rodríguez, MX.
KK-2021/00026 B-Ind5G - Federated Experimentation Infrastructure for applications Industry 4.0	60.379€	2021/03 - 2021/12	Mazuelas, S.
KK-2021/00048 ExpertIA - Evolution of industrial process modelling and control: advanced models combining expert knowledge with AI techniques in design and development	44.726€	2021/03 - 2022/12	Nava, V.
KK-2021/00091 REMEDY - Real Time Control and Embedded Security	64.676€	2021/07 - 2022/12	Rojas-Delgado, J.
KK-2021/00123 AUTOEV@L - Technology evolution for multi-vehicle automation and evaluation of highly automated driving functions	71.440€	2021/03 - 2022/12	Mazuelas, S.
KK-2021/00064 CiCe21 - Research on Material Models and Components for The Future Generation of Generation of Batteries in Mobility	53.629€	2021/03 - 2022/12	Akhmatskaya, E.
KK-2021/00022 ICME - Integrated Computational Materials Engineering	77.490 €	2021/03 - 2022/12	Akhmatskaya, E.

4.2.

Private funding

AXA 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: 2020/10 - 2023/09
- PI: Mazuelas, S.

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€
- Duration: 2020/09 - 2021/08
- PI: Nava, V.

Additionally, through the BCAM Knowledge Transfer Unit, the economic income of the centre related to industrial projects with companies amounts to 217,017 €.

4.2.1. PRIVATE INDIVIDUAL GRANTS



4.2.1.1. LA CAIXA – INPHINIT GRANTS AND JUNIOR LEADER PROGRAMME



2017
Bonifazi, G.
Grant: 321.300€

2020
Nagar, L.
Grant: 305.500€

2018
de Pitta, M.
Grant: 298.500€

2020
Balboa, F.
Grant: 297.900€

2021
Smirnov, I.
Grant: 297.900€

4.3.

Individual Grants

4.3.1.

EUROPEAN COMMISSION – H2020 – EXCELLENCE PILLAR

**H2020-MSCA-IF-SF-2018**

Project: 832332-MinSOL-PDEs (H2020) – Minimal solutions to nonlinear systems of PDEs
Grant: 160.932€
Duration: 19/12 – 22/04
PI: Zarnescu, A., Smyrnelis, P.

H2020-MSCA-IF-SF-2020

Project: 101021893 - ViBRheo (H2020) – Design of a Virtual Blood Rheometer for Thrombotic Process Characterization
Grant: 172.932€
Duration: 22/01– 23/09
PI: Ellero, M., Moreno, N.

H2020-MSCA-IF-GF 2018

Project: 842536 - AEROSIMULAT (H2020) – High-performance aerodynamics and aeroacoustics simulations of the new generation of high-speed gas turbines via high-order Galerkin methods
Grant: 245.732€
Duration: 20/09- 23/08
PI: Moragues, M.

H2020-MSCA-IF-GF 2020

Project: 101017984 - GEODPG (H2020) – Space-time DPG methods for partial-differential equations with geophysical applications
Grant: 263.732€
Duration: 22/01 – 24/12
PI: Pardo, D., Muñoz, J.

4.3.2.

SPANISH STATE RESEARCH AGENCY

**PREDOC 2016**

Beñaran, I., Abanda, A., Pallarés, I.
Grant: 274.200€

PREDOC 2017

Pérez, D M., Ceuca, R.D.
Grant: 182.800€

PREDOC 2018

Zumeta, L., Dahlenburg, M., Echeverria, M., Vinicio, F., Rodríguez, O.A.
Grant: 455.000€

PREDOC 2019

Uriarte, C., de la Bodega, J., Cañizares, M., Anam, V., Girier, G., Camarasa, M., Hernández, MA., Arza, E.
Grant: 763.600€

PREDOC 2020

Gorostidi, N., Gago, I., González, J., Gardezabal, I., Bidaurrezaga, A.
Grant: 494.800€

IJCI 2018

Incorporación Rincón, M.
Grant: 87.000€

IJCI 2019

Incorporación Szarek, T., Costa de Sousa M.
Grant: 186.000€

FJCI 2019

Formación García, MA. Ponce, F.
Grant: 100.000€

RYC 2016

Mazuelas, S.
Grant: 208.600€

RYC 2017

Bartoñ, M.
Grant: 308.600€

RYC 2018

Roncal, L.
Grant: 308.600€

RYC 2020

Smirnov, I.
Grant: 324.250€

4.3.3. BASQUE GOVERNMENT



PREDOC 2017
Canto, J.
Grant: 82.123€

POSTDOC 2017
Álvarez, J.
Grant: 110.964€

Grants for research staff training with institutions and companies 2020
Álvarez, V.
Grant: 18.750€



PREDOC 2019
Zaballa, O.
Grant: 82.123€

POSTDOC 2018
Muñoz, J.
Grant: 91.453€

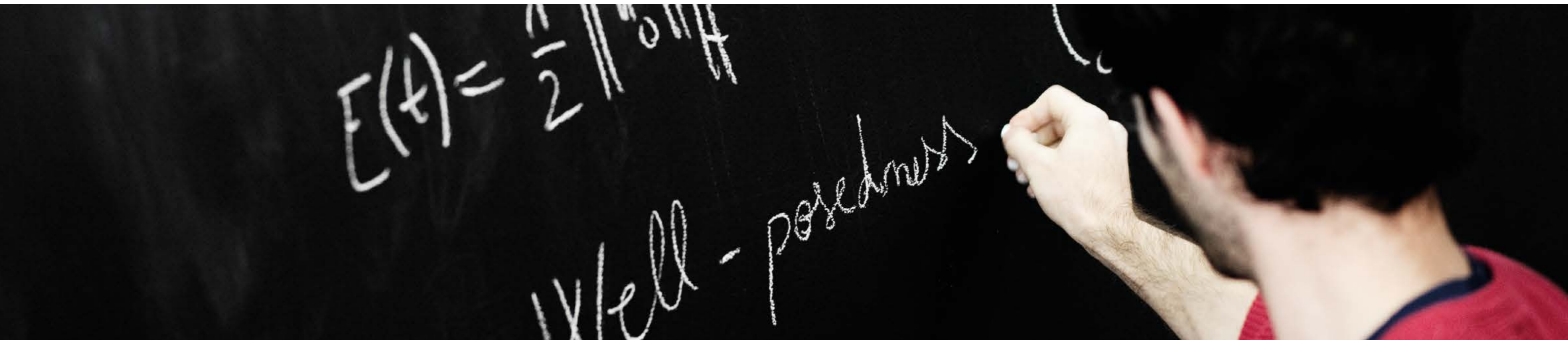
PREDOC 2020
Aldasoro, M.
Grant: 82.123€

4.4.

Funding institutions

DISTINCTIONS

PUBLIC FUNDING INSTITUTIONS



Scientific activities

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

5.1.

BCAM-SO Course Programme

In 2021 BCAM has introduced BCAM – Severo Ocho Course Programme in Pure Mathematics in which each course will be preceded by a general audience motivating lecture by a renowned expert in which the main aspects of the theory will be presented.

This programme has started with BCAM-Severo Ochoa Course: Group Cohomology and Bieri-Strebel-Neumann-Renz invariants given by Conchita Martinez (University of Zaragoza).

BCAM Courses

During 2021 BCAM has organized 7 courses oriented to the training of PhD students and research staff of BCAM and collaborators.

Considering the situation, the centre has managed to prepare different courses to give and increase a little bit the numbers of last year. In addition, some of the courses are available in BCAM YouTube channel.

1. **Geometric modeling by Bartoň, M. (BCAM)**
2. **Optimal Transport and Geometric Optics in complex media by Eric Stachura (Kennesaw State University)**
3. **From Lagrangian chaos to turbulence in dilute polymer solutions by Fouxon, I.**
4. **Invariant measures for Hamiltonian PDEs by Lucà, R. (BCAM)**
5. **Geometric approaches to integrable systems and their perturbations by Françoise, JP. (Sorbonne-Université)**
6. **Discrete Harmonic Analysis and its applications to Ergodic Theory given by Szarek, T. (BCAM)**
7. **Programing with evidence given by Zalakain, U. (University of Glasgow)**

5.2.

Colloquiums in Mathematics and its applications

Aiming to strengthen cooperation with other institutions, BCAM has reinforced its programme of joint Colloquiums, especially with the University of the Basque Country:



1. Tenth Math Colloquium BCAM-UPV/EHU

Modeling Pandemics of Mutating Virus in a Globally Connected World: A multi-scale active particles approach by Bellomo, N. (University of Granada).



2. Eleventh Math Colloquium BCAM-UPV/EHU

The solution of Enflo's problem by Volberg, A. (Michigan University State).

5.3.

Seminars

BCAM seminars programme 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.



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.

- The long and winding road towards dementia: an example from Alzheimer's progression by Bonifazi, G.
- Rubio de Francia square function: overview of some results by Flórez, M.
- Fractional Calculus and Material Clock Applied to Relaxation in Complex Systems by Lattanzi, A.
- The Hanoi Tower Group by Garciarena, M.

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.

- Estimating time-dependent transmission rates in Bayesian models based on compartmental dynamics by Inouzhe, H. (BCAM)
- Proving in Constructive Mathematics by Programming in Agda by Zalakain, U. (University of Glasgow)
- Stability of sharp Fourier restriction to spheres by Negro, G. (Birmingham University)

5.4.

Workshops and Conferences

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.



- Joint meeting APDE - Machine Learning



- Pixil Workshop - Exploring the subsurface for geothermal energy: A local and global perspective



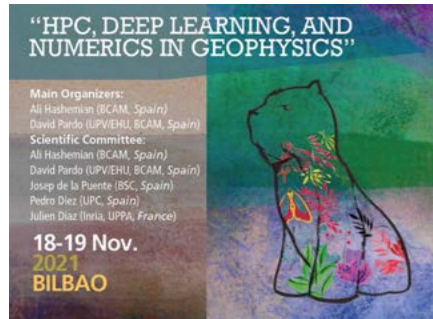
- Dynamical Systems Applied to Biology and Natural Science - DSABNS 2021



- SIAM Conference on Mathematical Aspects of Materials Science - MS 21



- Pixil Workshop: From science to praxis. Experiences employing geophysical methods to characterise geothermal anomalies



- First Bilbao Workshop on Algorithmic Fairness

- 35th International Workshop on Statistical Modelling

- ECLM PKDD 2021

- New Bridges between Mathematics and Data Science

- MATHROCKS - HPC, Deep Learning, and Numerics in Geophysics



5.5.

Working Groups

Working group sessions, oriented to the training of BCAM, postdoctoral fellows and PhD students. In fact, during 2021, mainly two research groups of BCAM have organized different working groups: APDE research area and MTB research line:

- 36 Joint BCAM-UPV/EHU Analysis and PDE seminar
- 16 MTB Group Seminar Series

Summer Courses

During 2021 summer, BCAM has been part of the organization of two summer school in collaboration with UPV/EHU and Basque Centre for Climate Change. These activities are the complement for students after a school year.

Artificial Intelligence for the Wellbeing and Sustainability of Societies



09 Jun - 11 Jun
Cod. 200-21

I Jornada sobre Inteligencia Artificial, ética y legislación



25 Jun
Cod. 020-21

- I Jornada sobre Inteligencia Artificial, ética y legislación
- Artificial Intelligence for the Wellbeing and Sustainability of Societies

5.6

Participation in international congresses and visits to other research centres

As part of its internationalisation work and as part of its scientific activities, members of the BCAM team participates in different congresses, conferences, workshops, etc. all over the world presenting their work, being an international reference in mathematics.

January 2021

- ECCOMAS 2020

April 2021

- AERC 2021

June 2021

- SMB 2021
- CEDYA 2020
- ICCS 2021
- 8 ECM
- ADMOS 2021

July 2021

- MCA 2021
- CMMSE 2021
- 16 USNCCM

September 2021

- SIMAI 2020 + 2021
- INdAM WORKSHOP
"Qualitative Properties of dispersive PDE"
- ECIS 2021
- RSS International conference 2021
- IRP DYN³BIO
- SEE Reunion Anual
- EMRS 2021
- CEDI 2021

October 2021

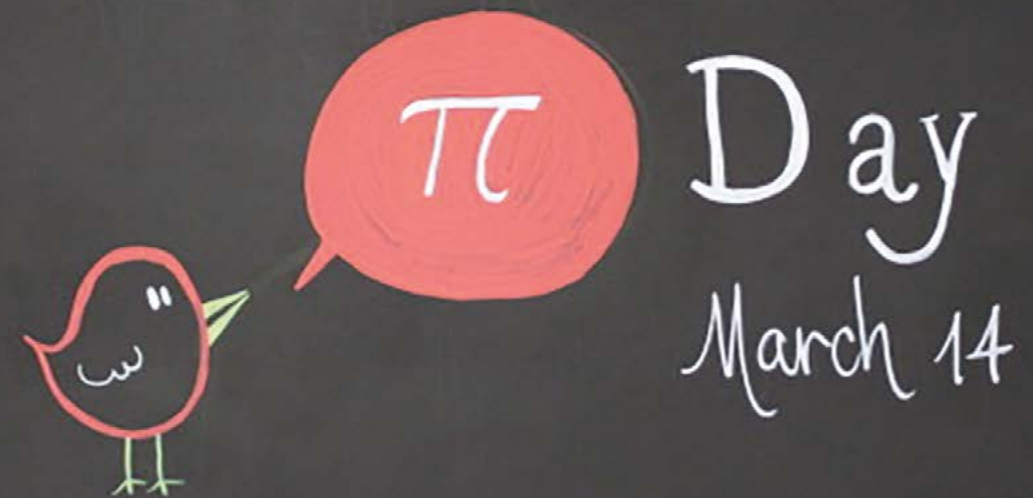
- Singularities (hybrid meeting)
- Summer School "Brascamp-Lieb inequalities"
- 17th International Dengue Course and other arboviruses in the context of COVID-19 pandemic
- Venice meeting on Fluctuations in small complex systems V
- Intl. Conference on Materials Science and Engineering 2021
- EAGE Annual Meeting 2021
- JEDE 2020

November 2021

- NBMDs 2021
- 100xciencia.5

December 2021

- IEEE ICDM 2021
- MODÈLES ASYMPTOTIQUES ET MÉTHODES NUMÉRIQUES POUR LES MILIEUX CONTINUS ET LA BIOLOGIE
- CMStatistics 2021



Publications

Frequency domain modelling of a coupled system of floating structure and mooring Lines: An application to a wave energy converter

Touzon I., Nava V., Gao Z., Petuya V.

(2021) *Ocean Engineering*, 220, art. no. 108498, DOI: 10.1016/j.oceaneng.2020.108498.

This paper introduces a numerical model of lumped mass for mooring lines and rigid body motions for the floating structure coupled by means of kinematic relations, and its subsequent linearization, which is solved in the frequency domain. The linearized model is applied to a two-body floating spar type oscillating water column, subject to the 36 most occurrent sea states at the BIMEP site. Its accuracy is verified through a comparison with the equivalent time domain simulation and a review of the results and its limitations are also pointed out.

Computational
Mathematics - CM

Mathematical
Design, Modelling
and Simulations
MATHDES

Dynamics and rheology of a suspension of super-paramagnetic chains under the combined effect of a shear flow and a rotating magnetic field

Rossi, E.; Ruiz-Lopez, J.A.; Vázquez-Quesada, A.; Ellero, M.

Soft Matter 17 (24), 6006-6019.

Suspensions of paramagnetic particles are useful in the formulation of complex fluids because of their tunable flow features. In fact, it is possible to control the mechanical properties of these magnetic suspensions by simply actuating them with specifically applied external magnetic fields. In this study, the structural and dynamical behavior of these magnetic suspensions undergoing a rotating magnetic field superimposed to a background shear flow is studied for the first time by means of numerical simulations.

Computational
Mathematics - CM

CFD Modelling and
Simulation - CFDMS

Tunnelling times, Larmor clock, and the elephant in the room

Sokolovski, D., Akhmatskaya, E.

Scientific Reports 11 (2021) 10040.

Using Quantum theory and mathematical rigor we show that the difficulty with applying a non-perturbing Larmor clock to “tunnelling time problem” arises from the quantum Uncertainty Principle. We demonstrate that for this reason a Larmor time cannot be interpreted as a physical time interval. We also provide a mathematical description of the quantities measured by the clock.

Mathematical Modelling
with Multidisciplinary
Applications - M3A

Modelling and
Simulation in Life
and Materials
Sciences MSLMS

Critical fluctuations in epidemic models explain COVID-19 post-lockdown dynamics

Aguiar, M., Van Dierdonck, J.B, Mar, J., Cusimano, N., Knopoff, DA., Anam, V. and Stollenwerk, N.

Scientific Reports, Vol. 11 No. 1, doi: 10.1038/s41598-021-93366-7 (2021).

We investigate critical fluctuations around the epidemiological threshold resembling new waves even when the community disease transmission is controlled. By using simple models as baseline, results are applied to more complex models describing COVID-19 epidemics in the Basque Country. Rather than a supercritical regime leading to new exponential growth of infection, a subcritical regime with small import explains the dynamic behavior of COVID-19 spreading after lockdown lifting in summer 2020.

Mathematical Modelling
with Multidisciplinary
Applications - M3A

Mathematical and
Theoretical Biology
MTB

Stochastic facilitation in heteroclinic communication channels

Sirio Carmantini, G., Schittler Neves, F., Timme, M. and Rodrigues, S.
Chaos 31, 093130 (2021).

Heteroclinic networks, emerging in artificial neural systems, are networks of saddles in state space that provide an approach to neural computations. Here, we investigate the information transmission properties of heteroclinic networks, seen as communication channels. We investigate the mutual information rate between input signals and the resulting sequences of states with varying noise. Our results show the constructive effect of stochastic facilitation on heteroclinic communication channels and on more general systems exhibiting state-space complex trajectories.

Mathematical Modelling
with Multidisciplinary
Applications - M3A

Mathematical,
Computational
and Experimental
Neuroscience - MCEN

Entanglement of Classical and Quantum Short-Range Dynamics in Mean-Field Systems

Bru, J-B., de Siqueira Pedra, W.
Ann. Phys. (N. Y.) 434 (2021) 168643.

We show the emergence of classical dynamics for quantum systems with mean-field interactions, without suppression of its quantum features, in the infinite volume limit. This leads to a theoretical framework in which the classical and quantum worlds are entangled. This is noteworthy and should not be restricted to systems with mean-field interactions, but should also appear in presence of long-range interactions, yielding classical background fields, in the spirit of the Higgs mechanism of quantum field theory.

Mathematical
Physics - MP

Quantum
Mechanics - QM

Should I stay or should I go? Zero-size jumps in random walks for Lévy flights.

Pagnini G., Vitali S.
Fract. Calc. Appl. Anal. 24, 137–167 (2021).

The paper focused on the role played by the shape of jump-distributions in random walks for anomalous diffusion. We provide an example of Lévy flights where the walker's jumps follow a bimodal power-law distribution and, as a consequence, it emerges a time-scale for large-time limit that spans up to infinity. Hence, the large-time limit could not be reached in real systems. The significance is two-fold with regard to: i) the probabilistic derivation of fractional diffusion equations and ii) to recurrence and site fidelity of wild animals in the framework of Lévy-like motion.

Mathematical
Physics - MP

Statistical Physics - SP

Moderately Discontinuous Homology

Fdez-Bobadilla, J., Heinze, S., Pe-Pereira M. and Sampaio, J. E.
Moderately Discontinuous Homology. Comm. Pure Appl. Math.

We introduce a new metric homology theory, which we call Moderately Discontinuous Homology, designed to capture Lipschitz properties of metric singular subanalytic germs. The main novelty of our approach is to allow “moderately discontinuous” chains, which are specially advantageous for capturing the subtleties of the outer metric phenomena. Our invariant is a collection of finitely generated graded abelian groups indexed by positive real numbers b and homomorphisms of the corresponding groups for any $b' > b$. Here b is a “discontinuity rate”. As applications we prove that Moderately Discontinuous Homology characterizes smooth germs among all complex analytic germs, and recovers the number of irreducible components of complex analytic germs and the embedded topological type of plane branches.

Mathematical
Physics - MP

Singularity Theory
and Algebraic
Geometry - STAG

Self-similar dynamics for the modified Korteweg–de Vries equation

Correia, S , Côte R. , Vega, L.
International Mathematics Research Notices 2021 (13), 9958-10013.

We prove the stability of the selfsimilar solutions of the modified Korteweg-De Vries equation (mKdV). mKdV is a canonical model for one dimensional non-linear dispersive waves that have a preferred direction of propagation. Among other things it appears related to The Fermi-Pasta-Ulam problem and to some models of Fluid Mechanics.

Analysis of Partial
Differential
Equations - APDE

Linear and
Non-Linear Waves
WAVE

Mathematical problems of nematic liquid crystals: between dynamical and stationary problems

Zarnescu, A.
Philos. Trans. Roy. Soc. A 379 (2021), no. 2201, Paper No. 20200432, 15 pp.

Mathematical studies of nematic liquid crystals address in general two rather different perspectives: That of fluid mechanics and that of calculus of variations. The former focuses on dynamical problems while the latter focuses on stationary ones. The two are usually studied with different mathematical tools and address different questions. The aim of this brief review is to give the practitioners in each area an introduction to some of the results and problems in the other area. Also, aiming to bridge the gap between the two communities, we will present a couple of research topics that generate natural connections between the two areas.

Analysis of Partial
Differential
Equations - APDE

Applied
Analysis - APAN

Discrete Carleman estimates and three balls inequalities

Fernández-Bertolin, A., Roncal, L., Rüländ, A. & Stan, D.
Calc. Var. Partial Differential Equations V. 60 (2021).

This paper is the first step to understand the differences between continuous and discrete frameworks for unique continuation principles (UCP). We study three balls inequalities in the discrete setting. Our contribution is a quantitative result providing such inequalities in the lattice with a correction term that vanishes as the step tends to zero. We show extensions to a large variety of discrete magnetic Schrödinger operators by means of a Carleman estimate for the discrete Laplacian.

Analysis of Partial
Differential
Equations - APDE

Harmonic
Analysis - HA

Prediction of sports injuries in football: a recurrent time-to-event approach using regularized Cox models

Zumeta-Olaskoaga, L., Weigert, M., Larruskain, J. et al.
ASTA Adv Stat Anal (2021).

Data-based methods and statistical models are given special attention to the study of sports injuries to understand its risk factors and mechanisms. Shared frailty Cox models are evaluated and compared by means of regularized methods variable selection approaches. The study is motivated by specific characteristics found for sports injury data, which usually include reduced sample size and a low number of injuries.

Data Science - DS

Applied
Statistics - AS

Probabilistic load forecasting based on adaptive online learning

Alvarez, V., Mazuelas, S., and Lozano, JA.
IEEE Transactions on Power Systems, vol. 36, no. 4, pp. 3668 – 3680, Jul. 2021.

Load forecasting is crucial for multiple energy management tasks such as scheduling generation capacity, planning supply and demand, and minimizing energy trade costs. This paper presents a method for probabilistic load forecasting based on the adaptive online learning of hidden Markov models. We propose learning and forecasting techniques with theoretical guarantees, and experimentally assess their performance in multiple scenarios. The results show that the proposed method can significantly improve the performance of existing techniques for a wide range of scenarios.

Data Science - DS

Machine Learning - ML

On the Effect of the Cooperation of Indicator-based Multi-Objective Evolutionary Algorithms

Falcón-Cardona, JG., Ishibuchi, H. Coello Coello, CA. and Emmerich, M.
IEEE Transactions on Evolutionary Computation, Vol. 25, No. 4, pp. 681-695, August 2021.

Our experimental results show that the cooperation of multiple IB-MOEAs allows IMIA to perform more robustly (considering several QIs) than the panmictic versions of its baseline IB-MOEAs as well as several state-of-the-art MOEAs. Additionally, IMIA shows a Pareto-front-shape invariance property, which makes it a remarkable optimizer when tackling MOPs with complex Pareto front geometries.

Data Science - DS

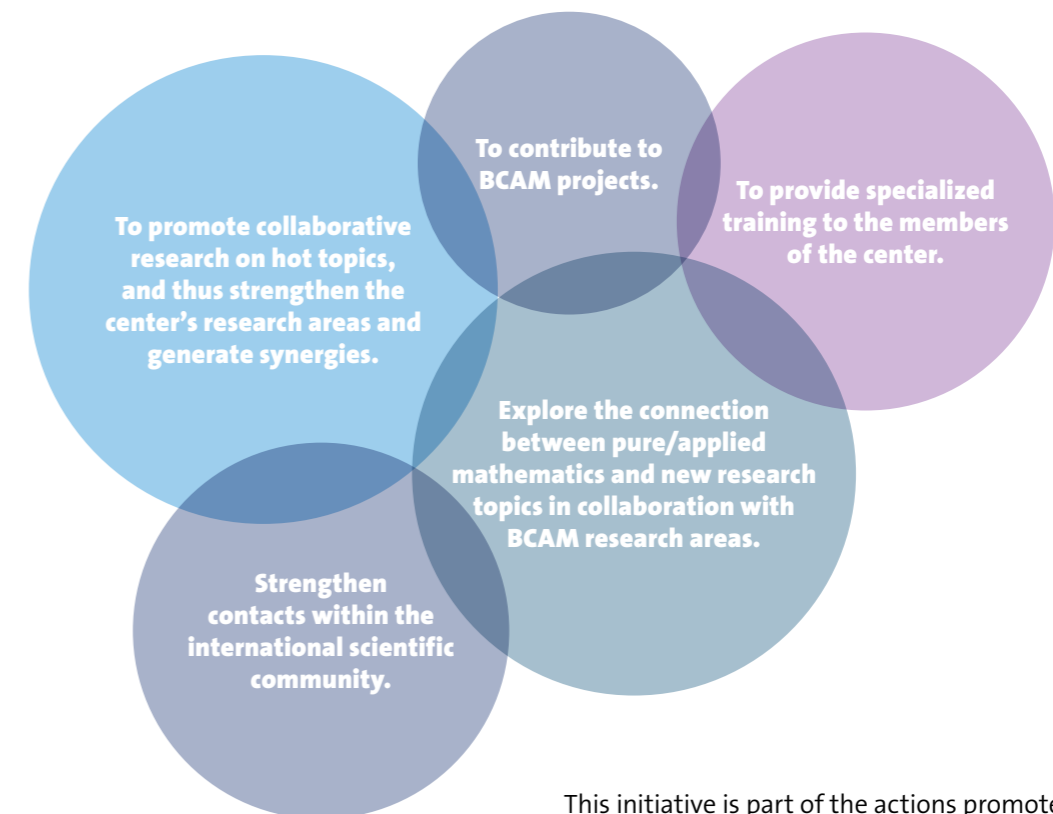
Combinatorial
Optimization - CO

The Severo Ochoa strategic research labs programme

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:



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.





Mathematical
Institute

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).

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.

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.

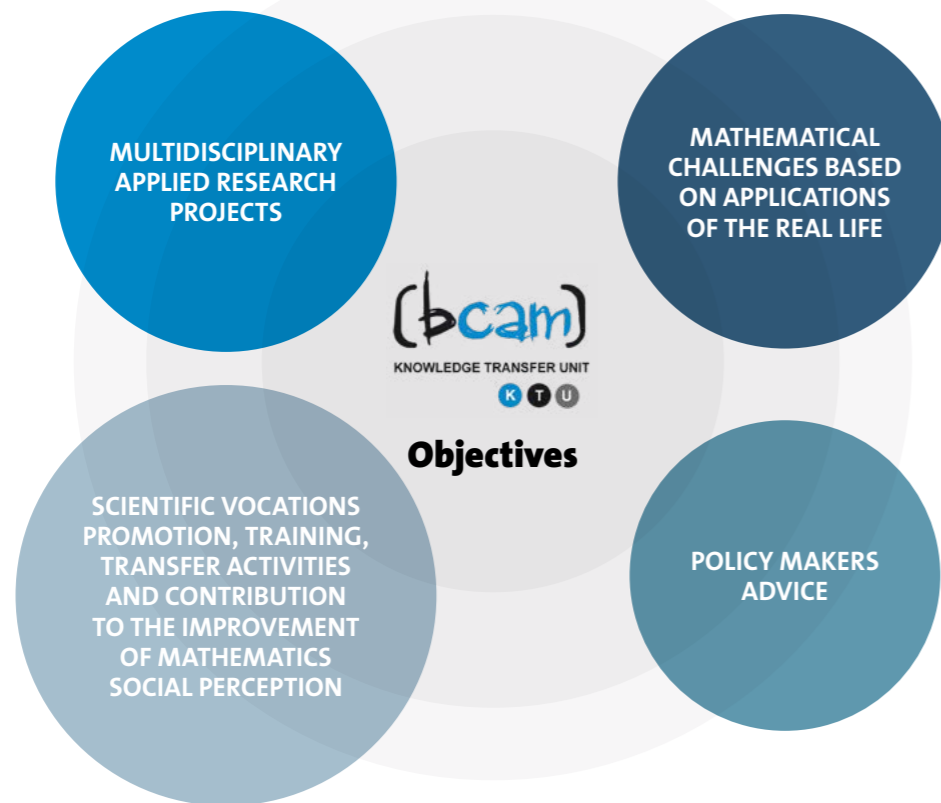
About Joaquim Serra:

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

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



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:

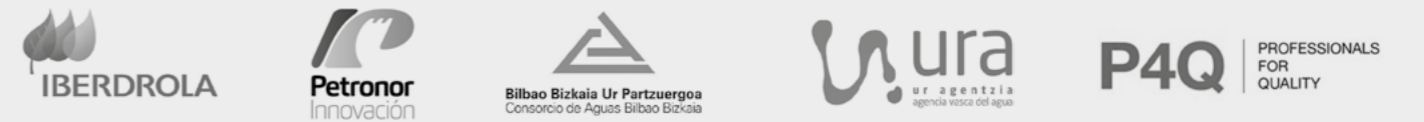
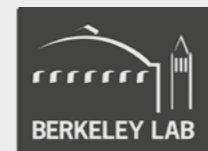
- **Strategic partnerships**
- **Collaborative R&D&I projects**
- **Joint positions / research teams**
- **Supervision of Master and PhD Students**
- **Training courses**
- **Organization of dissemination activities**

SUCCESS-STORIES

	<p>Project: Supervised learning with time series applied to electron beam welding</p> <p>Goal: Design and implement a model to predict non-conformities in turbine components</p>
	<p>Project: Daily water reservoir inflow estimation for water resources management</p> <p>Goal: Study of the relationship between the presence of SARS-COV2 in waste water treatment plants and the incidence of COVID-19 positive cases to develop a surveillance system for early detection of outbreaks</p>
	<p>Project: Statistical Modelling of SARV-COV2 in waste water treatment plants for the early detection of COVID-19 outbreaks in the Basque Country</p> <p>Goal: Study of the relationship between the presence of SARS-COV2 in waste water treatment plants and the incidence of COVID-19 positive cases to develop a surveillance system for early detection of outbreaks</p>
	<p>Project: Predictive algorithm for solar trackers batteries performance</p> <p>Goal: Development of machine learning algorithms to detect failures and the early ageing of batteries in solar trackers</p>

Joint positions

Knowledge transfer collaborations



Media and outreach activities

Following the work of bringing mathematics closer to society and showing its value, BCAM maintains its activity in different events for the dissemination of science. It continues to work to publicize the work of the centre and the work of mathematical research, working on the gender perspective and encouraging STEM vocations. In addition, BCAM continues to work to increase the community in the network.

Marzo, mes de las matemáticas

"March, Month of Mathematics" is an initiative for the dissemination of mathematics designed by Divulgación Matemática (DiMa), with the support of the entire mathematical community and the collaboration of the Spanish Foundation for Science and Technology - Ministry of Science and Innovation (FECYT). Several BCAM researchers participated:

11 RETOS EN EL FÚTBOL DESDE UNA PERSPECTIVA MATEMÁTICA

Jon Larruskain
Athletic Club

Dae-Jin Lee
Basque Center for Applied Mathematics

LA BELLEZA DE LAS MATEMÁTICAS SOLO SE MUESTRA A SUS SEGUIDORES MÁS PACIENTES

Javier Fernández de Bobadilla

Basque Center for Applied Mathematics

MATHS IS WHERE THE HEART IS. CÓMO LAS MATEMÁTICAS AYUDAN A ENTENDER EL FUNCIONAMIENTO DEL CORAZÓN

Nicole Cusimano

Basque Center for Applied Mathematics

CONFERENCIA ONLINE
VIERNES 12 DE MARZO DE 2020, 17H
LAS MATEMÁTICAS EN LOS PREMIOS PRINCESA DE ASTURIAS 2020

Luz Roncal
Basque Center for Applied Mathematics - BCAM

First Lego League

FIRST LEGO League Euskadi is an international educational program 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.

This year Lee, D. and Zumeta, L. have participated giving the talk "Mathematics for the prevention of injuries in football" where they explained the challenges in Wellness, Health and Sports from a mathematical research perspective within the framework of the collaboration agreement between BCAM and Athletic Club.



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 or technology and shows the labor reality, the diversity of professional profiles and the richness of the Basque industrial fabric.

In 2021 three PhD Students of BCAM, Zaballa, O., Camarasa, M. and Kobeaga, G., take part in the initiative to bring mathematics closer to young people.



STEAM
euskadi

STEAM Sare

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.

This time, Caro, P. has been in Bidebarrieta giving a talk about "Visibilidad e invisibilidad: dos caras de la misma moneda".



Parekoen topaketa - Bizilabe

The aim of this activity is to put secondary school students in contact with researchers or company employees to receive their contributions on the work previously prepared for the activity but, above all, to make visible how STEM is reflected in the professional reality.



Incubadora de sondeos y experimentos

The aim of this competition is to promote the teaching and learning of Statistics, Probability and Operations Research at non-university educational levels, as well as to broaden students' knowledge and skills in this field. The aim is also to disseminate the importance and usefulness of Statistics in real life and as a fundamental tool in practically all sciences.

As in previous editions, the jury was made up of members of BCAM's Applied Statistics (AS) group, including Lee, D. and members of his group.



Zientzia Astea

Zientzia Astea is the Science, Technology and Innovation Week organised by the University of the Basque Country/ Euskal Herriko Unibertsitatea for all those who are curious about what surrounds them, whether they are young or old, children or teenagers, to have the opportunity to see, listen, feel and talk about science with those who work in it on a daily basis.

This edition, Moreno, N. has taken part giving a talk entitled "Do you like COVID19? Well, we neither. How computational models can help us to fight it revealing hidden secrets of viruses?" where he has discussed how computational models can help us to hack the secrets of viruses that cannot be seen with the bare eye.



BCAM in the media

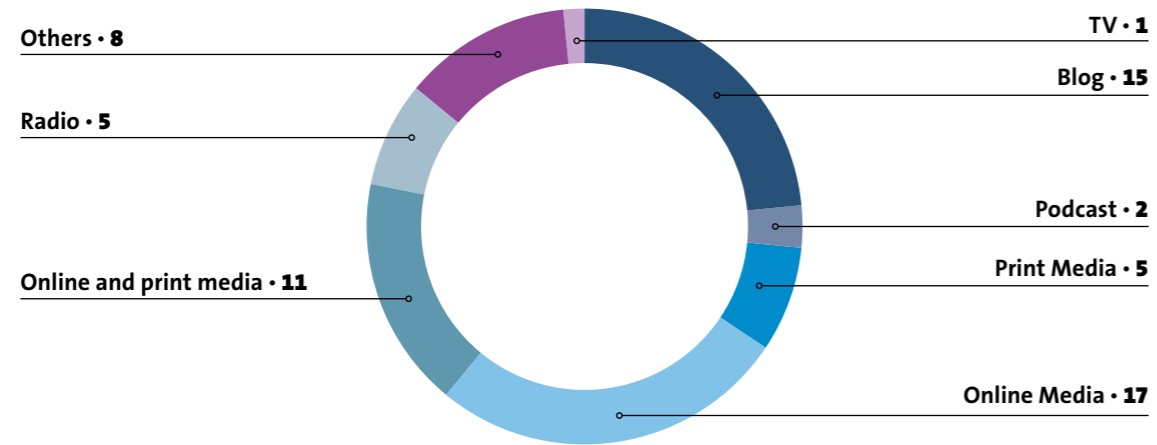
During 2021 BCAM has appeared in the media for different reasons. One of the main ones has been the National Research Prize awarded to Vega, L. Another important one has been the outreach activity "Marzo, mes de las matemáticas". Other themes include Covid and collaborations with the centre, such as Runnea and Innolab.

- **Premio Nacional de Investigación:** the Ministry of Science and Innovation has awarded the National Research Prizes, a total of 10, with the mathematics prize going to Luis Vega, BCAM researcher and Professor at the UPV/EHU. These awards are the most important recognition in Spain in the field of scientific research, a recognition the recognition of the long career of Vega, L.
- **"Marzo, mes de las matemáticas":** it has been a nationwide activity organized with the collaboration of different mathematical organizations and universities. At a local level, entities such as MetroBilbao have taken part, with the aim of bringing mathematics closer to society.
- **Runnea:** The collaboration with runnea is a collaboration with one of the most important companies in the field of running, where we work together in the development of the application for the personalised training of the users.
- **Innolab:** BCAM's KTU collaborates with different entities to bring the use of mathematics closer to their work. The collaboration with Innolab, an open innovation platform that connects companies and technology to find digital solutions to current business and social challenges, has led BCAM to collaborate with Bilbao Basket.

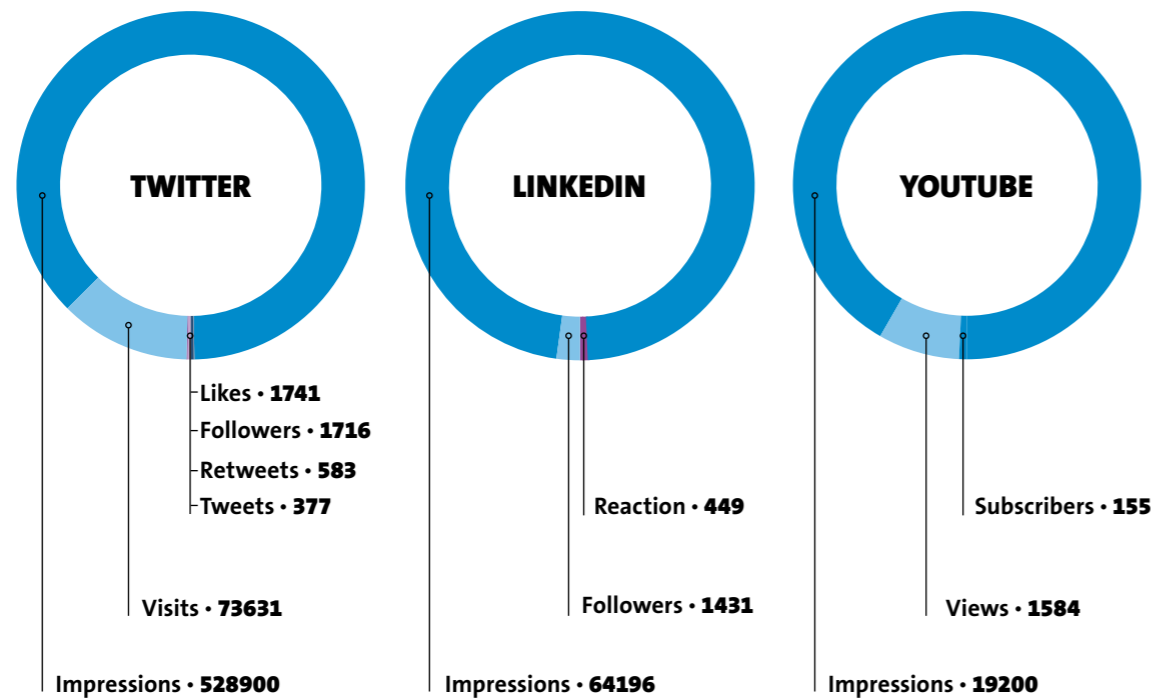


Bilbao Basket, BCAM e INNOLAB ponien fin a la primera fase del prototipo de una herramienta digital de coaching.

Having this impact in the media allows us to publicize the work of the centre and to bring society closer to mathematics and its applications.



Social media



Gender equality actions

BCAM works on giving a gender perspective to every action so as to eliminate inequalities and promote effective and real equality between women and men in the international area. To do so, BCAM works on different initiatives to promote women's research and foster the interest of younger girls in STEAM vocations. BCAM takes part in the following initiatives:

International Day of Women and Girls in Science to promote and improve the access and participation of women and girls in science. 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.

Dr. Christina Schenk, Postdoctoral Fellow.



Training on Sexual harassment and harassment on the basis of gender.



Contribution to the good practices in terms of Gender. report by SOMM excellence Alliance.



R-Ladies is a worldwide organization whose mission is to promote gender diversity in the R community. The R-Ladies Bilbao has been active since 2019 and in 2020 they have been collaborating with Wikitoki, a research and development laboratory around social, cultural, economic, political matters. In 2021, the R-Ladies held an event to discuss Taylor and Sailor: Diagrams.

PhD Students Diana Marcela Pérez and Lore Zumeta.



BCAM sponsors and supports MatEsElla, mentoring program to promote scientific or entrepreneurial careers among women undergraduate or master's degree students in STEM disciplines and to enhance the careers of women researchers.

*Lorea Gómez. BCAM General Manager
Administrative support: Idoia Hernández*



Sonali Das, Prof. at University of Pretoria, will come to BCAM to work with Dr. Dae-Jin Lee, group leader of Applied Statistics, by the collaboration with Women for Africa Foundation (FMxA). This collaboration promotes African women's leadership in scientific research and technology transfer and fosters the capacity of the research centres in their home countries.



Institutional member of the European Women in Mathematics, 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.



BCAM promotes the dissemination of projects and results of its researchers in order to bring the mathematics closer to the society.

Margarida Moragues interview on her Marie-Curie project AEROSIMULAT, in which she works in the numerical simulation of aircraft engine jet noise.

Maira Aguiar was interviewed in Elhuyar Magazine and talked about the ability of vaccines to prevent the transmission of the COVID-19.

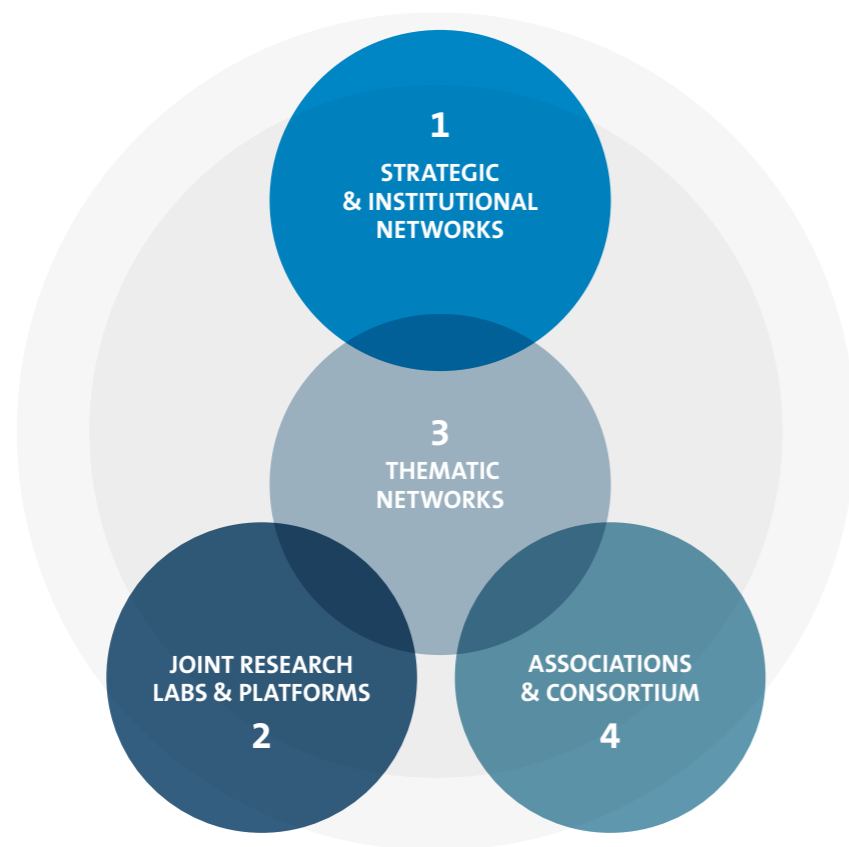


Networks and agreements

11.1.

Networks, joint labs and platforms

Being a multidisciplinary centre, 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:



1. Strategic & Institutional Networks

RCOM: 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 centres 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 centres 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.2020 that was postponed due to the COVID - 19 outbreak.



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.



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.



2. Joint research labs & platforms

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.



LTC-TRANSMATH: Joint Transborder Laboratory in Mathematics

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

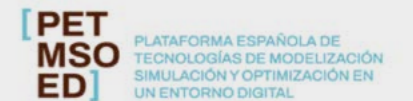
The Laboratories for Transborder Cooperation (LTCs) are a formula for collaboration that has been developed since 2015 in the frame of the Campus Euskampus (UPV/EHU)- U. Bordeaux. LTCs were created to provide an institutional framework for research teams from the Basque country and from Bordeaux working 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 i) increase scientific outputs and visibility of our joint research at the EU and international level and ii) 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 Modelling, 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 Modelling, Simulation and Optimization Technologies taking advantage of the resources of Data Science in a Digital Environment. BCAM is an institutional member of this platform since its promotion in 2021.



3. Thematic networks

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.



“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.



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).



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 MTB BCAM Research group from 2016 to 2020.



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 Applied Statistics (AS) BCAM Research group since 2016.



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 Mathematical and Computational Neurosciences (MCEN) BCAM Research group since 2020.



4. 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.



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.



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.



BAIC Basque Artificial Intelligence Center

<https://www.baic.eus/es/>

The BAIC Association, Basque Artificial Intelligence, was created with the aim of leading and promoting the development of Artificial Intelligence in the Basque Country "to improve business competitiveness and the wellbeing of Basque society". BAIC was created to be a space for public-private collaboration to promote Artificial Intelligence (AI) in the Basque Country, an instrument for its rapid adoption by industry, while serving as a laboratory for experimentation and acceleration of projects that serve as an international positioning in one of the greatest technological and social challenges. The aims of this partnership begin by promoting the development of Artificial Intelligence in the Basque Country and articulating the Basque Artificial Intelligence ecosystem.



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).



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.

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.



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 an 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 centre 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.

**RSME Real Sociedad Matemática Española – RSME**<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.

**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.



11.3.

Agreements

INTERNATIONAL AND NATIONAL AGREEMENTS

SPAIN

- 1 • Universidad A Coruña
- 2 • Universidad de Valencia
- 3 • Universidad Politécnica de Madrid
- 4 • Universidad de Santiago de Compostela
- 5 • Universidad de Cantabria
- 6 • Universidad de Valladolid
- 7 • Universidad Carlos III de Madrid
- 8 • BGSMATH
- 9 • Edro Fractal Systems S.L.

SWEDEN

- 1 • KTH Computer Science and Communication

FRANCE

- 1 • Toulouse University
- 2 • Bordeaux University
- 3 • INRIA Sophia Antipolis Mediterranean
- 4 • ISAE Institut Supérieur de l'Aéronautique et de l'Espace

UNITED KINGDOM

- 1 • School of Mathematics Bristol University
- 2 • Cranfield University
- 3 • Public Health England
- 4 • Swansea University

GERMANY

- 1 • Potsdam University
- 2 • Tuebingen University

ITALY

- 1 • Politécnico di Milano
- 2 • Università degli Studi di Napoli Federico II
- 3 • Scuola Internazionale Superiore di Studi Avanzati

AUSTRIA

- 1 • SCCH Software Competence Center Hagenberg

RUSSIA

- 1 • Ioffe Institute St. Petersburg

USA

- 1 • Computational Modeling Initiative, LLC
- 2 • UCLA University of California, Los Angeles
- 3 • Berkeley Labs

SAUDI ARABIA

- 1 • KAUST King Abdullah University of Science and Technology

INDIA

- 1 • University of Delhi, Cluster Innovation center

CANADA

- 1 • Wilfrid Laurier University

ARGENTINA

- 1 • YPF Argentina
- 2 • Universidad Nacional de La Plata

CHINA

- 1 • College of Sciences Shanghai University
- 2 • Tsinghua University - Electronic Engineering Department

SEVERO OCHOA JOINT LABS

UNITED KINGDOM

- 1 • Oxford University
- 2 • University of Sussex

SWITZERLAND

- 1 • ETH Zurich



2021

Activity
Report



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