Press pack

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WHAT IS BCAM?

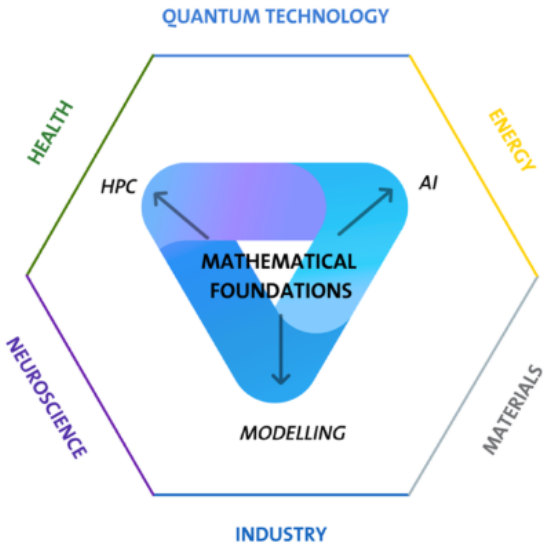
The Basque Centre for Applied Mathematics is an international research centre in the field of applied mathematics, established by the Basque Government's Department of Education and forming part of the BERC (Basque Excellence Research Centres) network.

It was established in 2008 by the Basque Government through Ikerbasque. It also receives support from the University of the Basque Country, the Provincial Council of Bizkaia, Innobasque and Petronor Innovation, and, since 2022, from Bilbao City Council.

One of its main objectives is to put mathematics at the service of society through knowledge transfer, extending the results of its research to sectors such as the biosciences, health, energy and advanced manufacturing, and working in partnership with local and international institutions and companies. It currently has a staff of over 150 researchers of 25 nationalities working in various fields, ranging from data science and computational mathematics to mathematical modelling.

BCAM has been accredited three times in a row—most recently in the 2021 round—as a 'Severo Ochoa' centre of excellence by the State Research Agency, a distinction awarded to the world's leading research institutions in their field.

SCIENTIFIC STRATEGY AND RESEARCH PROGRAMMES



BCAM's scientific strategy is based on the conviction that mathematics is a key driver of technological innovation and social progress. Designed to foster interdisciplinarity, agility and integration, this scientific strategy is modular and forward-looking, reflecting a firm commitment to mathematical excellence and social impact.

In an increasingly complex and interconnected world, mathematics provides the unifying language, conceptual rigour and computational tools necessary to develop robust and scalable solutions. To address this complexity, BCAM adopts a two-tier research architecture: Mathematical Foundations form the core, providing the theoretical basis for all scientific advances, and are complemented by three cross-cutting and closely interconnected areas: HPC (High-Performance Computing), AI and Mathematical Modelling.

Modelling structures complex problems, AI introduces learning and adaptability, and HPC ensures computational scalability. Together, they underpin research in six strategic application domains: **Energy, Materials, Health, Neuroscience, Quantum Technologies and Industry.**

This architecture ensures a continuous two-way flow between theory and application: fundamental mathematical advances enable applied innovations, whilst real-world challenges drive new theoretical developments. Designed to foster interdisciplinarity, agility and integration, BCAM's scientific strategy is modular and forward-looking, reflecting a firm commitment to mathematical excellence and social impact.

MATHEMATICAL FOUNDATIONS: GEOMETRY, ALGEBRA, ANALYSIS AND PARTIAL DERIVATIVE EQUATIONS (PDE)

This area forms the theoretical basis for all the Centre's activities, focusing on the study of forms, numerical structures and the laws governing change. In the field of geometry, the team investigates the connections between pure mathematics and high-energy physics, with notable achievements such as the resolution of the Zariski conjecture. Current projects aim to unravel open problems using advanced techniques that enable a better understanding of the structure of the universe at fundamental levels.

In algebra, the Centre utilises cutting-edge concepts such as perfectoid spaces to tackle challenges in arithmetic. At the same time, the Analysis and PDE programme studies complex systems through equations, covering everything from quantum mechanics to fluid turbulence and geophysical flows, with direct applications in engineering. A key priority is to mathematically describe turbulence—a phenomenon central to Nobel laureate Giorgio Parisi's work—by analysing how energy is redistributed within these systems.
Methodological advances are underpinned by modern analysis and multiscale tools, which have recently enabled the resolution of long-standing problems in harmonic analysis, such as Kakeya's conjecture and the local smoothing conjecture. These techniques place the programme at the frontier between the most abstract mathematical innovation and scientific applications that have a significant impact on society.

QUANTUM TECHNOLOGIES

The programme is divided into two strands: MAT4Q, which applies mathematics to quantum computing, and Q4MAT, which uses quantum logic to develop new mathematical tools. A key pillar is post-quantum cryptography (PQC), designed to protect our digital systems against the future threat posed by large-scale quantum computers. BCAM is working on the design of these new security shields in accordance with NIST's international standards.
This line of research is fully integrated into European networks and collaborates closely with industry in areas such as financial optimisation and hardware design. Internal synergy with other areas of the centre, such as AI and geometry, ensures that the knowledge generated translates into technological innovation and direct benefits for the industrial sector.

ENERGY

This programme drives the energy transition through the use of mathematical models and machine learning integrated into open-source software. Its strategy focuses on three key areas: the design of new materials, the smart management of electricity grids, and the efficiency of renewable energy sources such as offshore wind and geothermal energy. The aim is to create tools that predict the behaviour of next-generation batteries and optimise energy supply with theoretical guarantees.
BCAM collaborates with industry partners to validate these solutions, combining physical simulations with advanced artificial intelligence. The success of this approach has been recognised internationally, particularly for its ability to translate data science into practical engineering. In the future, research will focus on smart infrastructure maintenance and adaptive real-time energy forecasting.

MATERIALS

The Materials division aims to lead the way in the virtual design of fluids and smart materials essential to the green economy and bioengineering. Through high-performance computing (HPC), the centre accelerates the discovery of materials without the need for costly initial laboratory testing. One of its own innovations

is the use of neural networks that adhere to the laws of physics, enabling the creation of models that are far more accurate and easier for industry to interpret.
Priorities include the development of efficient materials for hydrogen transport and the multiscale simulation of complex fluids. This research is supported by a strong network of collaborations linking materials science with the needs of the global market.

INDUSTRY

Mathematics acts here as the driving force behind the ecological and technological transformation of Basque industry, in line with the Euskadi 2030 Plan. The programme focuses on Advanced Manufacturing and Industry 4.0, smart mobility and sustainability. Among its contributions, digital twins stand out; these are virtual replicas of industrial processes designed to optimise their performance and detect faults using AI. One success story is the ADAM^2 project, which has enabled the manufacture of microstructured components whilst saving material and maintaining the highest quality. Looking ahead, the centre will extend these digital platforms to infrastructure management and urban mobility, always prioritising artificial intelligence that is explainable and reliable for businesses.

HEALTH

Under the 'One Health' concept, this programme uses data analysis to integrate human, animal and environmental health. Mathematical models are developed for oncology, cardiovascular health and precision epidemiology. A recent milestone was the support provided to the Basque COVID-19 Modelling Task Force, whose mathematical predictions were crucial in guiding public health decisions during the pandemic.
The programme's agenda is structured around pillars such as epidemic modelling, mathematical oncology and the study of environmental processes. In addition to research, the programme is strongly committed to interdisciplinary training and the development of public policies that enhance the resilience of the healthcare system.

NEUROSCIENCE

This programme combines mathematics and AI to understand how the brain works and how to combat neurodegenerative diseases. The research aims to identify 'biomarkers' — biological indicators — that can help with the early detection of brain ageing and various conditions.

Thanks to collaboration with hospitals and clinical centres, the programme is making progress in the development of brain-machine interfaces and in the study of the dynamics of cerebrospinal fluid. The ultimate aim is to identify mathematical patterns that remain constant throughout life in order to better understand neural computation and the transport of substances within the brain.

SEVERO OCHOA STRATEGIC LABORATORIES

Backed by its accreditation as a 'Severo Ochoa Centre of Excellence' (2014–2026), this initiative aims to strengthen BCAM's research excellence and its international standing through global strategic partnerships. By fostering collaboration on high-impact topics — ranging from machine learning and fluid mechanics to mathematical modelling in healthcare — the programme aims to bridge the gap between pure and applied mathematics, generating new institutional synergies. These objectives will be achieved through specialised training, joint supervision of postdoctoral researchers and active participation in the international scientific community, thereby consolidating the Centre's role as a hub for cutting-edge mathematical innovation.

KNOWLEDGE TRANSFER UNIT (KTU) AND OUTREACH

KTU (Knowledge Transfer Unit)

Scientific excellence would not have its full impact without a robust strategy to transfer mathematical findings to industry and society as a whole. The BCAM's Technology Transfer Unit (KTU) is a driver of strategic innovation that operates across three areas of focus:

- Collaborative R&D Projects: The Centre forges partnerships with SMEs and large corporations to solve complex problems requiring advanced modelling. This ranges from the optimisation of logistics processes to the design of new superconducting materials.
- Intellectual Property and Licensing: BCAM promotes the creation of protected software and algorithms for transfer to the technology sector. This generates both direct financial revenue and tangible benefits for society by solving real-world challenges.
- Dual Talent Development: The Industrial PhD programme is a priority. These researchers carry out their theses at BCAM but apply their knowledge directly to problems posed by partner companies, ensuring a smooth, two-way transfer of knowledge.

OUTREACH AND PUBLIC COMMITMENT

The Centre views science as a public good. Its outreach strategy aims to promote a culture of mathematics in the Basque Country. BCAM is committed to a robust outreach and communication strategy, designed to bridge the gap between advanced mathematical research and society.

By fostering a community with a scientific culture, BCAM aims to demonstrate the vital role of mathematics in solving contemporary global problems, such as climate change and public health. This is achieved through a diverse range of public engagement initiatives, including scientific events, workshops and science fairs that translate the day-to-day work and projects of a Centre of Excellence in research into accessible knowledge for a wider audience and the general public.

Furthermore, BCAM prioritises collaboration with educational institutions to inspire the next generation of STEAM talent. By strengthening partnerships with schools and universities, BCAM develops specialised programmes that encourage students to explore career paths in mathematics and to interact directly with world-class research staff. These efforts are underpinned by feedback mechanisms, ensuring that communication remains effective, inclusive and aligned with the evolving needs of society.

The Human Resources Strategy For Researchers (HRS4R)

In early 2015, BCAM decided to take its commitment to people management a step further and began an internal review of the 'Human Resources Strategy for Researchers (HRS4R)' promoted by the European Commission. HRS4R is a mechanism designed to support the implementation of the European Charter for Researchers and the Code of Conduct for the Recruitment and Employment of Researchers (C&C).

The outcome of this process was the Internal Review and the 2016 Action Plan. As a result, in June 2016, BCAM was awarded the 'HR Excellence in Research' logo and recognition. In 2025, BCAM renewed its prestigious HR Excellence in Research accreditation. This renewal reaffirms the centre's commitment to the highest standards of human resources management and its dedication to creating a positive and supportive working environment for researchers.

In July 2018, two years after being awarded the 'Excellence in Human Resources in Research' accreditation, BCAM carried out a self-assessment process to review and improve the previous Action Plan. To this end, the status of each action defined in the 2016 Action Plan (BCAM HR Action Plan Review 2018) was analysed and a survey was conducted amongst all staff. As a result, BCAM carried out a gap analysis and drew up the Internal Review document.

BCAM continues to work on these principles and remains committed to the Charter, the Code and the HRS4R as part of the Centre's Strategy for the coming years. To this end, and based on the information obtained from the previous Internal Review, the HR Strategy and Action Plan for the next three years (2018–2021) have been drawn up. In 2021, BCAM carried out a new self-assessment process (2020 GAP Analysis), with the aim of drafting an Improved Action Plan for 2021–2024; following the completion of this, the subsequent Improved Action Plan for 2024–2027 was drawn up.

Women in Science

To achieve a gender-balanced community at BCAM, we are working to build one through a comprehensive, consultative and face-to-face selection process. The working environment is based on the values of respect and equality, regardless of sexual orientation, religion, culture or gender, to ensure equal treatment and a fair and balanced selection and assessment process. These values are upheld at all times, and BCAM has drawn up a Gender Equality Plan to implement all these measures and also to ensure that committees have an appropriate gender balance. This is achieved through a policy of equal opportunities in recruitment and at subsequent stages of a professional career, without this taking precedence over criteria of quality and competence.

Employers and/or funding bodies should aim for a representative gender balance at all staff levels, including supervisory and management levels. This should be achieved on the basis of a policy of equal opportunities in recruitment and at subsequent stages of a professional career, without, however, taking precedence over criteria of quality and competence. To ensure equal treatment, selection and assessment panels must have an appropriate gender balance.