The Centre of Excellence Programme for 2022-2029

CENTRES OF EXCELLENCE
IN RESEARCH

ACADEMY
OF FINLAND

CENTRES OF EXCELLENCE IN RESEARCH

The Academy of Finland's Centre of Excellence Programmes are a success story in Finnish research. Centres of Excellence (CoE) are at or near the international cutting edge of research in their field. They carve out new avenues for research, develop creative research environments and innovations, and train new talented researchers for the Finnish research and business sectors.

ACADEMY OF FINLAND

CENTRES OF EXCELLENCE
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Finnish Centres of Excellence in Research

The units granted CoE status by the Academy of Finland are scientifically first-rate research communities that have capacity for renewal and high societal impact. Thanks to the long-term funding provided by the Academy in collaboration with CoE host organisations, the funding instrument effectively facilitates risk-taking and new initiatives in research.

CoEs are jointly funded by the Academy of Finland, universities and research institutes. Funding is also made available through other sources.

The 2022—2029 Centre of Excellence Programme included 11 centres. They were composed of research teams from a total of eleven universities or research institutes. The Academy has earmarked a total of 101 million euros for the 2022–2029 Finnish Centre of Excellence programme.

www.aka.fi/coe

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Centre of Excellence in High-Speed Electromechanical Energy Conversion Systems

The world is being electrified at unparalleled pace, from transport to industrial processes and complete energy systems. As a result, there is an incomparable need for energy, material and cost-efficient electrical machines, drives and powertrains.

The aim of the Centre of Excellence in High-Speed Electromechanical Energy Conversion Systems is to elevate the modelling and analysis capabilities and methodologies eventually leading to the emergence of highly sustainable electrical machines, drives, mechanical transmission and related systems necessary for a cleaner future.

Website

Director:
Professor **Anouar Belahcen**,
Aalto University

CENTRES OF EXCELLENCE IN RESEARCH

Centre of Excellence in Tree Biology

The Centre of Excellence in Tree Biology studies how genes control the carbon sink effect of trees. Forest trees have a key role as sinks for the atmospheric greenhouse gas, carbon dioxide (CO_2). Trees take up the CO_2 through narrow openings in their leaves (called stomata). After fixing the CO_2 in their green chloroplasts to form carbohydrates (or sugars), these compounds are then transported to the trunk of the tree, where they provide building blocks for the plant biomass. A specific stem cell system (cambium) orchestrates the underlying radial growth.

The CoE analyses how forest tree individuals vary in their capacity to fix CO_2. The researchers will also use the information to breed trees that act as more efficient carbon sinks.

Website

Director:
Professor **Yrjö Helariutta**,
University of Helsinki

CENTRES OF EXCELLENCE
IN RESEARCH

Centre of Excellence in Biological Barrier Mechanics and Disease

Understanding how biological barriers function is one of the cornerstones of ensuring good health. In severe cases, however, failure of these barriers can lead to cancer or organ failure.

The goal of BarrierForce, the Centre of Excellence in Biological Barrier Mechanics and Disease, is to uncover how biological barriers are controlled at the level of molecules, cells and tissues. Based on this knowledge, the research will also elucidate how malfunctions of biological barriers lead to diseases, and how these diseases could be treated.

Website

Director:
Professor **Johanna Ivaska**,
University of Turku

CENTRES OF EXCELLENCE
IN RESEARCH

Centre of Excellence in Tax Systems Research

Because modern welfare states collect a very large share of national product as tax revenues, tax systems have a crucial role for economic performance. Identifying and measuring the pros and cons of taxation and planning a good tax system are also important societal issues.

The Centre of Excellence in Tax Systems Research studies features of the tax system and tax regulation using versatile methods in economics: statistical analyses with large administrative datasets and complementary survey data, randomised experiments and new theoretical modelling. The CoE carries out research that supports the development of the tax and transfer system. The research also sheds light on the effects of taxation on individuals, businesses and society at large.

Website

Director:
Professor **Kaisa Kotakorpi**,
Tampere University

CENTRES OF EXCELLENCE IN RESEARCH

Centre of Excellence in Quark Matter

The Centre of Excellence in Quark Matter studies the strong interaction between the fundamental constituents of ordinary matter, quarks and gluons. The goal of the CoE is to understand how these degrees of freedom become visible in high-energy collider experiments. In particular, the CoE addresses the question of how and when matter turns into a new state of deconfined quark matter, quark-gluon plasma.

The CoE consists of three theoretical and two experimental research teams. The research of the theory teams helps in understanding the properties of quarks and gluons using the measurements from the Large Hadron Collider (LHC) at CERN and from the world's most powerful microscope, the Electron-Ion Collider (EIC). The experimental teams are part of the ALICE collaboration, which operates one of the major LHC detectors, specialising in studying the properties of the quark-gluon plasma.

Website

Director:
Professor **Tuomas Lappi**,
University of Jyväskylä

CENTRES OF EXCELLENCE IN RESEARCH

Centre of Excellence in Learning Dynamics and Intervention Research

Learning problems (LP) have prevalence rates of approximately 10–20 per cent, and they have a huge impact on an individual's quality of life. They also place a great economic burden on education, health and social care.

The Centre of Excellence in Learning Dynamics and Intervention Research aims to produce knowledge of the neurobiological, cognitive, socio-emotional, motivational and environmental underpinnings of LPs. The researchers in the CoE will also examine how these factors affecting the development of LPs are linked – and why some people can and others cannot meet the demands of a rapidly changing society. The CoE also aims to develop more efficient means of support in various contexts of learning.

Website

Director:
Professor **Paavo Leppänen**,
University of Jyväskylä

CENTRES OF EXCELLENCE IN RESEARCH

Centre of Excellence in Life-Inspired Hybrid Materials

Biologically derived raw materials offer a way of making products in a more sustainable way. We can also draw inspiration from biology for new ways to achieve properties in materials.

The Centre of Excellence in Life-Inspired Hybrid Materials brings together research groups with backgrounds in bioscience, physics, chemistry and computational modelling to tackle problems that will advance hybrid materials. In particular, the researchers will take inspiration from lifelike properties such as how structures form, how cells grow and adapt, and how signals are transmitted and stored. This will allow the CoE's researchers to give materials new interactive properties and find new ways to make materials in general.

Website

Director:
Professor **Markus Linder**,
Aalto University

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Centre of Excellence in Randomness and Structures

The Finnish Centre of Excellence in Randomness and Structures (FiRST) especially aims at an improved understanding of the analytical and geometric properties of random structures. The CoE develops new analytical and geometric methodology and conducts research directly aimed at applications by developing high-performance statistical science, random algorithms and their geometric understanding for computational applications and machine learning.

Understanding of random structures is used, among other things, in modelling the flow of water in rock. This has application in the field of geothermal energy production. Another area of application is improved predictability of condensation models for atmospheric aerosols and, consequently, the models used in climate change predictions.

Website

Director:
Professor **Eero Saksman**,
University of Helsinki

CENTRES OF EXCELLENCE IN RESEARCH

Centre of Excellence in Music, Mind, Body and Brain

The Centre of Excellence in Music, Mind, Body and Brain studies music as a multimodal human experience and as a versatile engine of change, throughout the life span and in health and disease. The research is a combination of cognitive musicology, psychology, education, therapy, computer science and cognitive neuroscience.

The researchers will determine how the cognitive, emotional, embodied and interactional experience of music and the brain mechanisms underlying it change over the course of human life and in different disorders. They will also determine how music-based interventions can be optimised to enhance learning and emotional, cognitive, motor and social wellbeing. The results of the study can support not only everyday life but also educational and rehabilitation purposes.

Website

Director:
Professor **Petri Toiviainen**,
University of Jyväskylä

CENTRES OF EXCELLENCE IN RESEARCH

Virtual Laboratory for Molecular-Level Atmospheric Transformations

The Virtual Laboratory for Molecular-Level Atmospheric Transformations (VILMA) studies atmospheric aerosol formation. The formation of atmospheric aerosols is closely linked to two major challenges facing humankind: climate change and air quality. Atmospheric aerosols help to cool the climate, but they also cause increased mortality through poor air quality.

The CoE combines atmospheric and computer science to construct a virtual laboratory for atmospheric aerosol formation, interactively integrating experimental and theoretical state-of-the art methods from the fields of chemistry, physics and artificial intelligence. The objective is to produce new data that can support climate-related decision-making and the development of technology that improves air quality.

Website

Director:
Professor **Hanna Vehkamäki**,
University of Helsinki

TUTKIMUKSEN
HUIPPUYKSIKÖT

Multidisciplinary Centre of Excellence in Antimicrobial Resistance Research

Because the rise and spread of antimicrobial resistance is a complex problem, fighting it effectively requires a broad, multidisciplinary approach. The development and global spread of antimicrobial resistant bacteria has become a severe threat to both public and animal health. Antimicrobial resistance jeopardises our ability to treat bacterial infections, cure cancer and perform advanced surgery.

The Multidisciplinary Centre of Excellence in Antimicrobial Resistance Research will take a comprehensive approach to understanding the big picture of antimicrobial resistance from a "One Health" perspective that incorporates humans, animals and the environment.

Website

Director:
Professor **Marko Virta**,
University of Helsinki

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ACADEMY OF FINLAND

The Academy of Finland funds high-quality scientific research, provides expertise in science and science policy and strengthens the position of science and research in society. We work to contribute to the renewal, diversification and increasing internationalisation of Finnish research. We support and facilitate researcher training and research careers, internationalisation and the utilisation of research results.

Our activities cover the full spectrum of scientific disciplines. In 2022, our funding for research amounts to 468 million euros. We are a government agency within the administrative branch of the Finnish Ministry of Education, Science and Culture.

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