



CENTRES OF EXCELLENCE
IN RESEARCH

IN THE FOREFRONT
OF SCIENCE



CENTRES OF EXCELLENCE IN RESEARCH

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CENTRES OF EXCELLENCE – THE FLAGSHIPS OF FINNISH RESEARCH

Centres of Excellence are the flagships of Finnish research. They are at the very cutting edge of science in their fields, carving out new avenues for research, developing creative research environments and training new talented researchers for Finnish society and business and industry.

A Centre of Excellence is a research and training network that has a clearly defined set of research objectives and is run under a joint management. Funding is provided for a six-year term, which means that CoEs can work to long-term plans and even take risks. CoEs are jointly funded by the Academy of Finland, universities, research institutes and the private business sector.

The Academy has funded Centres of Excellence since 1995. The fifth CoE programme is scheduled to run from 2012 to 2017, and it involves 15 Centres of Excellence.

Lauri Aaltonen

FINNISH CENTRE OF EXCELLENCE IN
CANCER GENETICS RESEARCH
UNIVERSITY OF HELSINKI

THE FIRST LINE IN CANCER GENETICS

Cancer research in Finland is recognised as exceptionally high-quality. The field has an ambitious long-term target: to render meaningless the disease that is cancer through state-of-the-art gene technology and collaboration among leading experts from several disciplines.

Lauri Aaltonen

FINNISH CENTRE OF EXCELLENCE IN
CANCER GENETICS RESEARCH
UNIVERSITY OF HELSINKI

WHAT ARE THE AIMS OF YOUR RESEARCH?

Our CoE studies the aetiology and development of cancer, focusing especially on hereditary predisposition to tumours and somatic changes in neoplasia. In recent years, genome research has advanced at such a pace that we are now in the position to analyse the complete genome of the individual; both the germline as well as the respective tumour. But our interests span a much wider range and cover everything from epidemiology to computer science.

Our research has fine traditions. The first CoE in hereditary disorders research was founded in 1995, and CoEs in disease genetics and translational genome-scale biology followed in its footsteps. This history is reflected in the composition of our current CoE that is composed of five teams. We are a multidisciplinary unit in a way that everyone can understand.

We are currently conducting genome-wide analyses in lines of research that we believe hold the greatest promise. This is generating vast quantities of data as work is being done on up to a thousand samples at the same time. This data flow is managed in two stages. First, using the tools of computer science, we perform sophisticated sequence analyses, sorting millions of sequence reads into optimal order. This allows us to identify real differences between samples from among the background noise.

Next, our systems biologists set to work to find out which part of the variation has to do with tumour predisposition. Once we have formed an impression, we conduct searches in the Finnish Cancer Registry in order to identify



Academy Professor Lauri Aaltonen

other similar patients. This is a unique register providing details on all cancer cases diagnosed since 1953, a total of some one million patients. It serves as a virtual biobank and a research register with relevant information on every patient and tissue sample. The support we are receiving from the Academy through the CoE programme means we can now hire a full-time researcher to work in the Cancer Registry.

HOW WILL YOUR RESEARCH CHANGE THE WORLD?

If our studies uncover gene mutations that explain hereditary tumour susceptibility, we will have at our disposal a predictive test. This will allow us to translate the findings into clinical tools to reduce cancer morbidity and mortality. There are hundreds of families in Finland that according to our studies show mutations indicative of hereditary

predisposition. Clinical screening programmes have been made available for the individuals at risk. The incidence of colon cancer, for instance, has significantly decreased in at-risk families.

Furthermore, together with our partners, we have studied how the information gained from genetic cancer research impacts people's quality of life.

In principle, our research mission will be complete once cancer has become little more than a minor inconvenience. And we are convinced this will happen – not during the term of this CoE, but certainly in the long run.

WHAT IS IT THAT MAKES YOU A CENTRE OF EXCELLENCE?

When the Academy announced the CoE call, things happened very quickly indeed. We knew how we would set up our organisation and what research themes we would pursue in a matter of minutes! We set ourselves the target of creating a set-up of leading experts from different fields, who together would make up a stronger force than the sum of their individual efforts.

“We’ve taken on the role of bell ringer and messenger in relation to the Ministry of Social Affairs and Health and other policy-makers”

CoE FACTS

Total number of research staff: Just over 50

Sites of research: University of Helsinki and Finnish Cancer Registry

Number of research staff recruited from abroad: Nine. We are not the most international unit because our research relies heavily on Finnish research infrastructures.

Average age of research staff: 35 years

Total budget for first three-year term (2012–2014): 22.8 million euros. Academy funding is crucial, but we also have significant funding from other sources.



We would have worked together in this set-up, at least at some levels, regardless of the outcome, but funding through the CoE programme means firm commitment and a longer-term view to cooperation.

We are a very significant CoE in terms of our social impact as well because we are pioneering the studies of the whole human genome. This type of information is extremely valuable and at the same time sensitive, too. Genetic information can help improve everyone's quality of life, but there are potential problems in obtaining this information. The interpretation of genetic information is still in its infancy, and the infrastructure for using that information in public healthcare, for instance, still remains underdeveloped.

This is why we have taken on the role of bell ringer and messenger in relation to the Ministry of Social Affairs and Health and other policy-makers. Significant benefits and major drawbacks are at stake, and making sure we can achieve the former and avoid the latter requires significant input in training and education.

Uskali Mäki

FINNISH CENTRE OF EXCELLENCE IN
PHILOSOPHY OF THE SOCIAL SCIENCES
UNIVERSITY OF HELSINKI

INTERDISCIPLINARY BRIDGE-BUILDER

The focus of our research is on the changing practices of knowledge production and interdisciplinary dynamics in its contemporary setting. Among the main targets are interdisciplinary relations within social sciences and between them and other fields such as cognitive neuroscience and evolutionary biology. Through empirical case studies we examine the conceptual frameworks, methods and models used in these disciplines. We seek to understand their similarities, differences and interactions by way of an analysis of their intellectual toolboxes.

One aim is to understand and improve the practices of knowledge production by identifying and analysing strategic concepts, arguments and debates. By studying interdisciplinary encounters as well as the lack of interdisciplinary connections, we aspire to contribute to building bridges between different disciplines more generally.

To a greater extent than is customary in the case of the humanities and social sciences, our CoE encourages collaborative research, dialogue and as co-authoring, also with practitioners in the target disciplines.



Professor Uskali Mäki

“By studying interdisciplinary encounters as well as the lack of interdisciplinary connections, we aspire to contribute to building bridges between different disciplines more generally”

The research team consists of devoted philosophers of science and scholars of the ontology of social reality, all world-class experts in their respective fields.

CoE FACTS

Total number of research staff: More than 20

Site of research: University of Helsinki

Number of research staff recruited from abroad:

Only a few, but number will rise considerably.

Average age of research staff: 44 years

Total budget for first three-year term (2012–2014): 2.5 million euros

Marja-Leena Sorjonen

FINNISH CENTRE OF EXCELLENCE IN
INTERSUBJECTIVITY IN INTERACTION
UNIVERSITY OF HELSINKI

FOCUS ON MUTUAL UNDERSTANDING



Professor Marja-Leena Sorjonen

“The CoE is home to a multilingual and multidisciplinary community of researchers specialising in linguistics, social sciences and speech science”

Our research focus is intersubjectivity, the achievement and maintenance of mutual understanding in the context of human interaction. The CoE is home to a multilingual and multidisciplinary community of researchers specialising in linguistics, social sciences and speech science. The common denominator in our work is ethnomethodological conversation analysis. In addition, we apply the tools of interactional linguistics, construction grammar, psycho-physiological methods and the study of gestures.

Much of our research is handwork. Using our extensive collections of audio and video recordings of different types of interaction situations, our aim is to find answers to three main questions: First, we are interested in how mutual understanding is reached in interaction through the construction, identification and interpretation of actions and sequences of actions. Second, our aim is to describe in detail how structures of language support the achievement of mutual understanding among the parties to interaction. Our third area of focus is the role of emotions in social interaction. Our main focus is on Finnish and Finland Swedish.

CoE FACTS

Total number of research staff: About 40. However, not all of us engage in research full-time but also have teaching duties.

Site of research: University of Helsinki

Number of research staff recruited from abroad: 3

Average age of research staff: About 35 years

Total budget for first three-year term (2012–2014): 5.3 million euros

AIMS

The CoE programme is designed to strengthen the competitiveness of Finnish research and to increase its visibility and appreciation. In addition, it is aimed at developing creative and productive research and researcher training environments that generate excellence and contribute to the overall progress of science and society.

The CoE programme facilitates the establishing of research consortia between different fields of science and research. It promotes the efficient and cost-effective use of research infrastructures and opens up new opportunities for increased national and international cooperation. Furthermore, the CoE programme creates favourable conditions for scientific breakthroughs and in this way stimulates the regeneration of science and research.

In general, the CoE programme supports the development of the Finnish research system.

A photograph of two scientists in a laboratory. On the left, a man with glasses and a light blue sweater is smiling. On the right, a man in a maroon sweater is looking towards the camera. They are standing behind a computer monitor and a microscope. The background is a bright, clean laboratory environment.

Risto Nieminen

FINNISH CENTRE OF EXCELLENCE IN
COMPUTATIONAL NANOSCIENCE
AALTO UNIVERSITY

IN SEARCH OF ANSWERS AT THE ATOM AND MOLECULE LEVEL

Nature itself has chosen to operate on the nanoscale when creating the functional structures necessary for the maintenance of life. This is why the new materials arising out of nanoscience research will contribute to meeting the biggest challenges faced by humankind.

Risto Nieminen

FINNISH CENTRE OF EXCELLENCE IN
COMPUTATIONAL NANOSCIENCE
AALTO UNIVERSITY

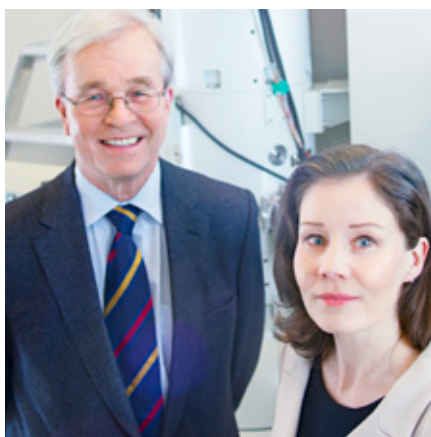
WHAT ARE THE AIMS OF YOUR RESEARCH?

Our CoE is focused on researching and understanding structures and systems at the atom and molecule level from a materials physics point of view. This is a fascinating field of study that comprises a rich variety of phenomena and that constantly brings up surprises in the shape of new discoveries.

Conceptually, our work is grounded in quantum physics, and we have a very solid theoretical framework whose foundations were originally laid in the 1930s. But today, of course, we no longer have to operate with abstract concepts only. One distinctive feature of our CoE is that a large part of our work draws on computer-based methods, modelling and large-scale computation.

Nanoscience has paved the way to a synthesis of several branches of natural sciences, with physicists, chemists, biologists and materials scientists all working on the same research problems. Common areas of interest range from DNA molecules to electronics materials.

Our mission is to harness the methods of nanoscale research to find answers to the major issues facing humankind, which include securing the energy sup-



Professors Risto Nieminen and Päivi Törmä

ply, water cleanliness, environmental protection, novel information technologies and advanced medical treatments. Catalysis research is one of the areas that brings us close to raw materials and chemical industry. Apart from basic research interests, a major motivation for our work comes from the needs of society.

HOW WILL YOUR RESEARCH CHANGE THE WORLD?

The sight of nanoscience is always set beyond the horizon. Since it is hard to predict new discoveries, the flexibility that comes with CoE funding from the Academy is just what we need in our field of research. However, that does not mean we can switch off and take a nine-to-five attitude. We are as committed as ever, at all levels.

“Since it’s hard to predict new discoveries, the flexibility that comes with CoE funding from the Academy is just what we need in our field of research”



While nanoscience research never reaches closure, the work of all our nine research teams is organised in projects. Each project has not just general objectives in the realm of basic research, but also some very specific and concrete goals that they are expected to deliver.

The best way to sum up our research is to describe it as natural sciences and engineering research aimed at improving the quality of life and the environment. A concrete example is the modelling of the energy transfer mechanisms in photosynthesis, which is a complex and exotic, partly a quantum physical process. If we succeed in identifying and modelling its mechanisms theoretically and computationally, then we can also create the process artificially.

Nanostructures and nanomaterials are made in two different ways. The first way is to create something completely novel using building blocks that are already available. This is how humans work: the great nanomachine that is our body produces proteins, for instance, to the accuracy of an atom. The other approach is miniaturisation,

which is the traditional approach taken to the manufacture of microelectronics and nanoelectronics components, for instance.

WHAT IS IT THAT MAKES YOU A CENTRE OF EXCELLENCE?

The leaders of our CoE have always done an excellent job in their three core tasks: recruitment, recruitment and recruitment. You need to have talented people to get your research centre onto a positive spiral, which in turn will lead to good results, publications and more funding.

Another key principle – and for us this is a crucial foundation for CoEs – is working to a long-term horizon of up to decades. We have managed to build up an exceptionally broadly based team of leading-edge computational science experts. At the same time, the large size of our CoE means we are in the position to allocate a large number of researchers to address a specific issue from very different perspectives and using different approaches.

We are known for our exceptional standards of postgraduate training, which has produced a number of professors who are now working at top universities both at home and abroad.

We have always worked closely with other research institutes and industrial partners. One area in which we devote special effort is the development of new materials and nanoscale structures that have practical applications.

Our aim is to be where others aspire to be.

CoE FACTS

Total number of research staff: About 90 – we have grown organically.

Sites of research: Aalto University and Tampere University of Technology

Number of research staff recruited from abroad: About 30

Average age of research staff: Just under 35 years. Most are doctoral students and postdoc researchers. Among team leaders the age structure is well balanced.

Total budget for first three-year term (2012–2014): 9.2 million euros

Jukka Pekola

FINNISH CENTRE OF EXCELLENCE IN LOW TEMPERATURE QUANTUM PHENOMENA AND DEVICES
AALTO UNIVERSITY

COLD SCIENCE

Our mission is to investigate quantum phenomena at low temperatures and to identify possible applications. Some of our research faculty work at temperatures very close to absolute zero to study such low temperature phenomena as superfluids. Another increasingly important research focus in this field includes phenomena in nanostructures. Work at our own CoE concentrates on the area of nanoelectronics where quantum phenomena are significant, as well as thermal phenomena on nanoscale and nanomechanics.

More specifically, research at our CoE includes charge and heat transfer and related fluctuations, and mechanical motion governed by quantum mechanics. The materials we study include helium superfluids, superconductors, graphene and carbon nanotubes as well as ordinary metals.



Professor Jukka Pekola

“Some of our research faculty work at temperatures very close to absolute zero”

CoE FACTS

Total number of research staff: About 70

Sites of research: Aalto University and VTT Technical Research Centre of Finland

Number of research staff recruited from abroad: Around 25

Average age of research staff: About 35 years

Total budget for first three-year term (2012–2014): 20.8 million euros

Lassi Päivärinta

FINNISH CENTRE OF EXCELLENCE IN INVERSE PROBLEMS RESEARCH
UNIVERSITY OF HELSINKI

FROM THEOREMS TO PATENTS



Professor Lassi Päivärinta

“For us, research is a way of life, a passion and an adventure”

The exact natural sciences are all based on solutions to inverse problems: their foundation lies in inferences drawn from experimental knowledge and interpretations of that knowledge within the frame of mathematical models. Our CoE engages in multidisciplinary research that ranges from the results of pure mathematics to industrial and commercial applications. This is made possible by our application of mathematical formalism.

Our aim is to produce workable and well-reasoned solutions to practical inverse problems. This serves to demonstrate the power of mathematical methods with the phenomenal accumulation and growing complexity of experimental knowledge and mathematical models.

The problems we address include medical and industrial imaging, asteroid modelling, new-generation radar measurements, biomass and carbon footprint measurements, and practical invisibility techniques.

Based at six universities, our teams make up an integrated and interactive network in the fields of mathematics, physics, statistics and computational science. For us, research is a way of life, a passion and an adventure.

CoE FACTS

Total number of research staff: About 77

Sites of research: University of Helsinki, University of Jyväskylä, University of Oulu, University of Eastern Finland, Tampere University of Technology and Lappeenranta University of Technology

Number of research staff recruited from abroad: About 15

Average age of research staff: About 34 years

Total budget for first three-year term (2012–2014): 8.8 million euros

IMPACT

CoE programmes are the most notable success stories of Finnish research. They have laid the foundation for the development of creative and productive research and training environments that advance internationally pioneering research. The programmes have brought increased international visibility to Finnish research, showcasing the best that Finnish science and research have to offer.

CoE programmes have broad-ranging impact on Finnish research as well as on the research, development and innovation field. They are also extremely important environments for training and education.

The added value gained from CoE programmes is mainly reflected in the improvement of research environments and research cooperation. An ambitious and high-quality research environment is best placed to produce new top researchers, new ideas, new methods and new approaches.



Markku Kivinen

FINNISH CENTRE OF EXCELLENCE IN RUSSIAN
STUDIES – CHOICES OF RUSSIAN MODERNISATION
UNIVERSITY OF HELSINKI, ALEKSANTERI INSTITUTE

MAPPING THE DIMENSIONS OF RUSSIAN MODERNISATION

The Russian nation is facing a number of important choices in the years ahead. The researchers at the Aleksanteri Institute are going to examine the structuration of the new Russian society and the challenges of modernisation.

Markku Kivinen

FINNISH CENTRE OF EXCELLENCE IN RUSSIAN STUDIES – CHOICES OF RUSSIAN MODERNISATION
UNIVERSITY OF HELSINKI, ALEKSANTERI INSTITUTE

WHAT ARE THE AIMS OF YOUR RESEARCH?

Quite a lot of research is being conducted on Russia at the moment, but no-one is looking at the country as an integral whole. Instead, what we see is economists studying economy, political scientists politics, cultural scholars culture. However, it is impossible to understand the Russian economy without considering politics, which in turn is very much influenced by culture. For this reason, we have set up a multidisciplinary research team, which will be looking at the entire whole from the same research perspective. Our aim is to create a new paradigm, challenging current prevailing views. In this sense, Finland could emerge as a superpower in Russian studies.

We will be exploring Russia's modernisation from multiple angles – at the macro, meso and micro level, as well as from a historical viewpoint. Specific concerns at the macro level include changes in the political, social and economic system, while the focus at the micro level will be, for instance, on consumers and entrepreneurs. In other words, our research agenda covers Russia as a whole, from major issues to small details, from past to future.

We will be applying a broad range of research tools. We have at our disposal



Professor Markku Kivinen

extensive interview and statistical materials dating from the final years of the Soviet Union to the present day. These will help us analyse the development of social structures, for instance. Anthropological observations, archive materials and case studies will in turn allow us to identify the challenges of modernisation at the micro level. Wherever possible, we will also try to enter behind the scenes by interviewing anonymous experts, so uncovering the interests of different parties.

HOW WILL YOUR RESEARCH CHANGE THE WORLD?

Our plan is to publish the book on Russia's modernisation par excellence. It will give politicians and authorities both in Finland and abroad the background they need for informed policy-making

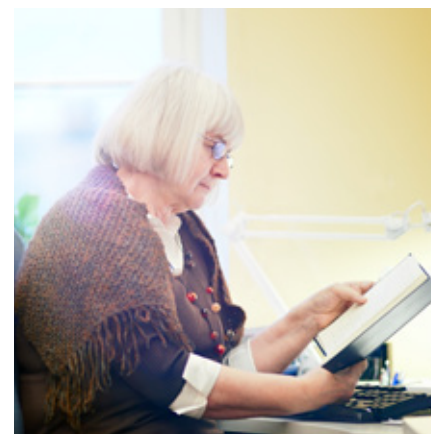
in developing relations between Russia and the European Union.

At a more practical level, exports of Finnish innovations to Russia may help resolve some difficult challenges in the social and healthcare sector. In other words, our research will also benefit Finnish companies, NGOs and authorities that have contact with Russia on a daily basis.

Ultimately, the most significant result is the ending of the Cold War. Both Russia and the United States still have strategic nuclear weapons ready to launch, and Russia has still not been integrated fully into Western structures. This is an enormous global challenge, where failure is not an option.

WHAT IS IT THAT MAKES YOU A CENTRE OF EXCELLENCE?

We have a great team and great team players. The different perspectives inside



the group complement one another. We are not interested in studying only the Russian elite, but also everyday life, institutions and grassroots activities. Our research team is built around the key choices that Russia has to make regarding modernisation: economic diversification, the development of democracy and the welfare state, foreign policy and cultural identity. However, the research teams all share a common point of departure and they are all committed to the same objective. Our aim is to become a world-leading research centre in this field.

It would not be possible to study Russian modernisation without intensive national and international networking. Our CoE combines the drive of ambitious young scholars and the intellectual capital of more experienced researchers. CoE funding means that what we can achieve is no longer a matter of resources – now it only depends on ourselves and our abilities.

CoE FACTS

Total number of research staff: About 40

Sites of research: University of Helsinki and University of Tampere

Number of research staff recruited from abroad: 5–6. One team leader is Russian. All projects involve international cooperation.

Average age of research staff: About 40. The social sciences and humanities are typically disciplines where it is very rare for younger scholars to reach the very highest level.

Total budget for first three-year term (2012–2014): 4.2 million euros

Erkki Oja

FINNISH CENTRE OF EXCELLENCE IN
COMPUTATIONAL INFERENCE
AALTO UNIVERSITY

IN SEARCH OF MEANINGFUL INFORMATION

Our main specialisation is in computational inference, a discipline that falls in the middle ground between computer science, data analysis and statistics. More and more often today, research in different fields draws on existing datasets, and it is crucial to know how to identify and extract information that is relevant to end-users. This trend is most clearly evident in biomedicine and molecular biology. We conduct computational methods research, where one of the key resources is adequate computational and data storage capacity.

We are a pioneer in the development of increasingly powerful computational inference methods for application in systems biology and medicine. Another important field of application is the development of new types of interfaces that can be used on the move to search for real-time information about items in the environment.

Our CoE comprises seven research teams from Aalto University and the University of Helsinki. We work closely with other groups both at home and abroad, and attach special priority to the training of young researchers. Indeed,



Professor Erkki Oja

“We’re a pioneer in the development of increasingly powerful computational inference methods for application in systems biology and medicine”

it has been shown that we deliver high-quality research that is at the cutting edge internationally.

CoE FACTS

Total number of research staff: 77

Sites of research: Aalto University and University of Helsinki

Number of research staff recruited from abroad: 24

Average age of research staff: 33 years

Total budget for first three-year term (2012–2014): 15.2 million euros

Matej Orešič

FINNISH CENTRE OF EXCELLENCE IN MOLECULAR
SYSTEMS IMMUNOLOGY AND PHYSIOLOGY RESEARCH
VTT TECHNICAL RESEARCH CENTRE OF FINLAND

UNDERSTANDING MOLECULAR MECHANISMS



Research Professor Matej Orešič

“We’re one of the global leaders in metabolomics as applied to biomedical research”

Comprehending living organisms in the context of coordinated gene and molecular function and translation of this knowledge into better human health is a great challenge and one of the central aims of medical systems biology.

Our CoE in Molecular Systems Immunology and Physiology Research (SyMMYS), comprising five research teams, is highly interdisciplinary and translational, covering competencies from clinical immunology and cohort studies to molecular systems immunology, metabolomics, diagnostics and computational systems biology.

Our objective is to understand the molecular mechanisms that control the immune system as well as the interactions between the immune system and other physiological systems in health and disease. With this knowledge we hope to create novel treatment and prevention strategies of inflammatory or immune-mediated disorders.

In our CoE, valuable and unique clinical resources such as the Finnish Type 1 Diabetes Prediction and Prevention study are integrated with state-of-the-art systems biology and immunology and cutting-edge research infrastructure.

CoE FACTS

Total number of research staff: 90

Sites of research: VTT Technical Research Centre of Finland, University of Helsinki, University of Turku, Aalto University, Hospital District of Southwest Finland

Number of research staff recruited from abroad: 30

Average age of research staff: Slightly under 30

Total budget for first three-year term (2012–2014): 5.5 million euros

SELECTION

The key criteria on which Centres of Excellence are selected are the quality, importance and innovativeness of their work. Other factors that are considered include the feasibility of their research plan, the qualifications of team members, networking contacts and the contribution to the promotion of professional research careers and researcher training.

CoE applicants are also assessed in terms of how they compare with the standards of the international forefront. Furthermore, the added value from the CoE and the significance of its research are weighed, together with the impact of its research on society and business and industry.

CoE programme calls are divided into two stages. Selection is based on thorough international peer reviews.

Johanna Mappes

FINNISH CENTRE OF EXCELLENCE IN
BIOLOGICAL INTERACTIONS RESEARCH
UNIVERSITY OF JYVÄSKYLÄ

SEEKING TO UNDERSTAND THE NATURAL ENVIRONMENT

Biological interactions pervade all of life's complexity. Why does in some cases collaboration, and in other cases conflicts emerge in bacteria, social insects and humans? The answers may be surprisingly similar.

Johanna Mappes

FINNISH CENTRE OF EXCELLENCE IN
BIOLOGICAL INTERACTIONS RESEARCH
UNIVERSITY OF JYVÄSKYLÄ

WHAT ARE THE AIMS OF YOUR RESEARCH?

We are particularly interested in events occurring between different organisms, and between different individuals of the same species. The big questions for us are often the same regardless of whether we are studying plants, fungi, insects, bacteria, humans or complete ecosystems. These interactions can be based on either cooperation or competition, and may entail predator-prey or host-parasite interactions, or social interactions within a single species. Surprisingly often we see conflicts of interest between different levels of organisation, individuals and populations.

A comprehensive and in-depth study of biological interactions requires that we have a common frame of reference. For us, that frame of reference is natural selection, which acts at all levels of life.

HOW WILL YOUR RESEARCH CHANGE THE WORLD?

One of the most ambitious objectives in all natural science research is to achieve predictability. For instance, we would like to understand the pathogenic mechanisms of *Flavobacterium columnare*,

“We have much to learn even from the most primitive forms of life and still apply our research concept to the challenges faced by society”



Academy Professor Johanna Mappes

which causes disease in both cultured and wild fish, and is responsible for yearly losses worth billions of euros. Or how and why does the Colorado potato beetle spread to Finland. The answers to these questions will allow us to create models for predicting such events. Thus, our aim is not to remedy failures, but to understand causes and predict consequences based on the analysis of interactions.

We have much to learn even from the most primitive forms of life and still apply our research concept to the challenges faced by society. Biological questions in nature conservation and the major environmental problems of our day are ultimately outcomes of conflicts of interest. That is why it is important to make people aware of behavioural models that date back to prehistoric times.



Such conflict situations keep recurring. People understand that the task or duty they are assigned may impact the whole community. Conversely, as individuals they may consider action an inconvenience that they would rather avoid. The same concept can be applied to a host of other processes, from the payment of taxes and air pollution to shared grazing and overfishing.

The only way we can hope to change human behaviour is by education and incentives. Economists, trainers and various authorities, for instance, are extremely interested in understanding what makes groups work together rather than against each other.

WHAT IS IT THAT MAKES YOU A CENTRE OF EXCELLENCE?

Our aim is to take a new and more practical approach to the study of biological interactions. We have an exceptionally diverse team that includes virologists, microbiologists, behavioural ecologists, geneticists, physiologists and theoreticians. We hope that our excitement and enthusiasm is conveyed in the work we do.

Everyone is really excited about the future research challenges and discoveries that lie ahead. We are now in the position to take a longer-term focus and tackle even tougher challenges. We can even take risks now – something without which many genuinely new innovations would never happen.

Our CoE includes research teams from the University of Jyväskylä and the University of Helsinki. We strive to create close links of cooperation between the two cities so that everyone can exchange ideas and expertise regardless of where they are based. For our younger researchers in particular this is a great opportunity for networking.



CoE FACTS

Total number of research staff: A dynamic team of about 50 researchers

Sites of research: University of Jyväskylä and University of Helsinki

Number of research staff recruited from abroad: More than 30%.
Researchers on one team represent eight different nationalities.

Average age of research staff: Just under 35 years

Total budget for first three-year term (2012–2014): 4.6 million euros

Rauno Julin

FINNISH CENTRE OF EXCELLENCE IN
NUCLEAR AND ACCELERATOR BASED PHYSICS
UNIVERSITY OF JYVÄSKYLÄ

IN THE NUCLEUS OF ATOMS

Nearly all the matter that surrounds us is held in the nuclei of atoms, most of which are unstable. In all, there are around 8,000 possible species of nuclides, but no more than some 3,000 of them have so far been observed. The focus of research at our CoE is on the structure of nuclei with extreme numbers of protons or neutrons (exotic nuclei).

Our CoE is made up of four teams. At the Department of Physics of the University of Jyväskylä, we engage in experimental and theoretical research in nuclear physics. We also work to develop practical applications using accelerator technology and ion beams. We use state-of-the-art equipment, including three accelerators at the university's Accelerator Laboratory.

We have now been granted CoE status for a third time, a great achievement that has required us to reinvent ourselves time and again. We have shown that it is indeed possible in Finland to develop a major research infrastructure for experimental and theoretical research that is operated in conjunction with a university. We also provide diverse training in this field.



Professor Rauno Julin

“We’ve now been granted CoE status for a third time, a great achievement that has required us to reinvent ourselves time and again”

CoE FACTS

Total number of research staff: 65

Site of research: University of Jyväskylä

Number of research staff recruited from abroad: 18

Average age of research staff: 35 years

Total budget for first three-year term (2012–2014): 9.2 million euros

Markku Leskelä

FINNISH CENTRE OF EXCELLENCE IN
ATOMIC LAYER DEPOSITION (ALD)
UNIVERSITY OF HELSINKI

ULTRA-THIN ALD FILMS



Professor Markku Leskelä

“The added value of the CoE originates from a unique combination of excellence in the fields of chemistry, physics and electronics”

Our CoE is committed to chemistry research and development, with special focus on the manufacture of ultra-thin films using the atomic layer deposition or ALD method. Major applications for ALD films are found in the field of

microelectronics, nanotechnology and the energy sector.

The CoE in Atomic Layer Deposition comprises the Thin Film Group at the University of Helsinki Laboratory of Inorganic Chemistry; the Materials Physics Division at the University of Helsinki Department of Physics; and VTT Microsystems and Nanoelectronics. Each team has its own primary area of expertise and its own tasks. The CoE is extensively networked both nationally and internationally, and we work closely with industrial partners.

Our aim is to develop new ALD processes for materials that are used in various microelectronics components, such as memories and microelectromechanical systems (MEMS), nanostructure solar panels and lithium-ion batteries and various optical and optoelectronic components.

We have a world-leading position in the development of ALD processes. This we have achieved with long and pioneering research. The added value of the CoE originates from a unique combination of excellence in the fields of chemistry, physics and electronics.

CoE FACTS

Total number of research staff: About 40

Sites of research: University of Helsinki and VTT Technical Research Centre of Finland

Number of research staff recruited from abroad: About 15; number will increase with time.

Average age of research staff: 32 years (excl. senior research fellows)

Total budget for first three-year term (2012–2014): 7.3 million euros

ACADEMY OF FINLAND: LEADING THE WAY IN SCIENCE

The Academy of Finland provides funding for cutting-edge and innovative research aimed at significant breakthroughs. The Academy is the country's leading expert organisation in science and science-policy issues, and in that role is committed to strengthening the position of science and research. Our overriding aim is to support the renewal, diversification and internationalisation of Finnish research.

The Academy offers various funding opportunities to support individual researchers at different stages of their career. We facilitate researcher training and research careers, promote internationalisation and further the practical application of research results. We also encourage researchers to submit boundary-breaking, high-risk but high-quality research plans that offer potential for scientifically significant breakthroughs.

All funding decisions taken by the Academy are based on open competition and independent international peer reviews.

Previous CoE programmes:

1995–1999	17 CoEs
2000–2005	26 CoEs
2002–2007	16 CoEs
2006–2011	23 CoEs
2008–2013	18 CoEs

For more information, go to www.aka.fi/coe.

Taina Pihlajaniemi

FINNISH CENTRE OF EXCELLENCE IN
CELL-EXTRACELLULAR MATRIX RESEARCH
UNIVERSITY OF OULU

MEDIATOR, DECISION-MAKER, ADVISOR

The extracellular matrix has many crucial roles to play. In order to gain a true picture of how the human organism works, we need to consider the constant interaction between cells and the extracellular matrix.



Taina Pihlajaniemi

FINNISH CENTRE OF EXCELLENCE IN
CELL-EXTRACELLULAR MATRIX RESEARCH
UNIVERSITY OF OULU

WHAT ARE THE AIMS OF YOUR RESEARCH?

Our aim is to understand the dialogue that goes on between cells and the extracellular matrix, a process that is necessary for the formation and normal function of organs and blood vessels, as well as in cancers and other types of diseases. We are also interested to explore the functions of stem cells in the processes of renewal and differentiation. The new understanding gained from these studies will lead to improved diagnostics and treatments during our current CoE term.

The extracellular matrix is not just a support structure but an extremely diverse and active agent. It works at once as a messenger and as a regulator of disease processes. The extracellular matrix provides behaviour cues to cells, and creates a physical barrier to the progression of cancer.

Our work rests on the foundation laid by the Collagen Research Unit established in 1982 with funding from the Academy of Finland and the University of Oulu. However, over the years the direction of our research has changed and evolved. Today, the six teams at our CoE combine their views and approaches in a new way. Our focus is to study extracellular molecules and their effects on cell behaviour, signalling molecules that regulate cell development and differen-

“We want to facilitate the detection of cancer and treatment before the disease progresses too far”



Professor Taina Pihlajaniemi

tiation, the effects of tissue oxygen partial pressure, DNA changes impacting on cell wellbeing and balance of cell regeneration as well as the effect of mechanical stimuli. Our aim is to understand the combined effects of all these areas in various tissue environments.

HOW WILL YOUR RESEARCH CHANGE THE WORLD?

The field in which we work is very attractive, highly competitive and very challenging. Furthermore, the practical applications can be quite surprising and may surface in completely unexpected areas. Due to the wide range of possible applications alone, there are lots of interested parties.

One of our visions is to be able to grow replacement organs from individual cells. The number of kidney patients, for instance, far outstrips the number of donors.

Our aim is to do research that will help identify mechanisms of malignant cell transformation and ultimately lead to new diagnostic methods and treatments. We want to facilitate the detection of cancer and treatment before the disease progresses too far.

One area in which we are active is in developing new tools for breast cancer screening. We have, for instance, identified a novel recurrent constitutional gene mutation that predisposes to breast cancer, and a pilot project at Oulu University Hospital is looking into this mutation to see whether it could have wider application in screening programmes associated to genetic counselling.

WHAT IS IT THAT MAKES YOU A CENTRE OF EXCELLENCE?

Our CoE has unique competencies and models that can help us model aberrant gene function in laboratory conditions. For instance, we have cell cultivation and experimental animal models for kidneys, hair follicles, mammary glands, bones and blood vessels.

Our projects are organised into distinct successive stages. First, we will use



CoE FACTS

Total number of research staff: 85

Site of research: University of Oulu

Number of research staff recruited from abroad: More than 20%

Average age of research staff: About 32 years

Total budget for first three-year term (2012–2014): 14.2 million euros



cell cultivation models to test molecules that we have identified in gene-level analyses as potential regulators of tissue development. The focus here is to consider the significance of these genes to cell differentiation. At the next stage, we proceed to experimental animal models, which we then analyse in order to try and determine what really happens in the organism. In other words, we do not only work at the level of cell cultivation models, but the results of our studies can be translated into practical use in clinical treatments.

Another thing that sets us apart from other research units in the country is our recruitment policy. Since the basic research we do requires a long-term horizon, our aim is to hire not only biochemistry, cell biology and genetics students, but also medical students who are only in their second year. This gives them a hands-on research opportunity and they can start work on their doctoral thesis at as early a stage as possible. This system has worked excellently, providing young scientists a chance to spread their wings in an inspiring but challenging environment. We are a very active, brave and knowledge-hungry bunch of people.

Pertti Haapala

HISTORY OF SOCIETY:
RETHINKING FINLAND 1400–2000
UNIVERSITY OF TAMPERE

RETHINKING NATIONAL HISTORY

Our mission is to research the construction of society and identities from a historical point of view and to find out how people form an understanding of their history. Our main goal is to contribute to a rethinking of the history of Finnish society, but our research interests are relevant to all countries, and to modern nation states in particular. The CoE is a joint project of the University of Tampere, the University of Jyväskylä and Åbo Akademi University. These three universities provide sufficient critical mass and expertise for our undertaking.

Conceptions of history have great social and political significance. What we want to do is give these conceptions a good dusting down and show how critical historical information really is. No one else dares or has the capacity to assess that information than researchers themselves. Rather than argue that history has been written wrongly, we show the alternative way of seeing our past.

We have extensive experience of research into Finnish society, a tightly knit community, good international contacts – and above all a bold view on the task ahead.



Professor Pertti Haapala

“Rather than argue that history has been written wrongly, we show the alternative way of seeing our past”

CoE FACTS

Total number of research staff: 34

Site of research: University of Tampere

Number of research staff recruited from abroad: 5

Average age of research staff: Age range from 30 to over 60

Total budget for first three-year term (2012–2014): 4 million euros

Ilkka Hanski

FINNISH CENTRE OF EXCELLENCE IN
METAPOPOPULATION RESEARCH
UNIVERSITY OF HELSINKI

WHAT ARE THE CONSEQUENCES OF HABITAT FRAGMENTATION?



Academy Professor Ilkka Hanski

“One of the greatest strengths of the CoE is the ability to integrate theoretical and empirical research in the same projects”

The Metapopulation Research Group is an international, multidisciplinary group of scientists working on spatial ecology and the consequences of habitat fragmentation on the ecology and genetic structure of populations and their evolution.

The scientists and students working at the CoE come from very different backgrounds, ranging from ecology to genetics and genomics to mathematics and computer science. One of the greatest strengths of the CoE is the ability to integrate theoretical and empirical research in the same projects. This is greatly facilitated by close daily interactions among the scientists and students.

The mission of the CoE is to create new knowledge and understanding of how the spatial structure of the environment affects the dynamics of natural populations. Our aim is to understand the biology of natural populations from the molecular level through to the population and landscape levels. We also aim to produce and disseminate information and methods that have practical application in conservation and land use planning.

CoE FACTS

Total number of research staff: 44

Site of research: University of Helsinki

Number of research staff recruited from abroad: 19

Average age of research staff: 35 years

Total budget for first three-year term (2012–2014): About 10 million euros



ACADEMY OF FINLAND

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