



Danmarks  
Grundforskningsfond  
Danish National  
Research Foundation

# THE DANISH NATIONAL RESEARCH FOUNDATION 1991-2016





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## "25<sup>TH</sup> ANNIVERSARY"

The Danish National Research Foundation is fortunate in its scientists and in its founders. Using the 2 billion DKK in revenue from selling a public insurance company in 1990, then Minister for Education and Research Bertel Haarder and others established the Danish National Research Foundation (DNRF) as an independent public foundation with the aim of supporting superb basic research in Denmark.

The DNRF is also unique on a global scale with its Centers of Excellence, which are granted up to 10 years of funding to conduct outstanding basic research in all fields of science. The centers operate in a framework of freedom, flexibility and trust. The success of the centers is all about people, and we do our utmost to find the right center leaders and Niels Bohr professors. Now, after 25 years of operation, evaluations of the foundation have demonstrated that our DNRF researchers are on a par with the best in the world; thus, the DNRF modus operandi has obtained "proof of principle."

For us, it is a privilege to serve the DNRF, and we thank all of the founders, all previous and current researchers in the DNRF family, all previous board members and Directors, and all those working in the secretariat. You have all been gears in a clockwork that has now been ticking continuously for 25 years for the benefit of science and society in Denmark and internationally. Half of our researchers are from abroad, and all research centers have a close collaboration with the best researchers all over the world. The DNRF has been important in the internationalization of the Danish research communities and universities.

Wise politicians and decision makers have initiated and supported the foundation from

the very beginning, and we would like to acknowledge this support.

The purpose of science is to gain new knowledge, to update research-based education, and to introduce innovation into industry and society. Science brings new knowledge needed to secure good lives in the future, and the arts and sciences together serve as antidotes to short-term thinking.

In this publication about the first 25 years, we celebrate the researchers in the first 100 Centers of Excellence, 10 Danish-Chinese Research Centers, and 15 Niels Bohr visiting professors and DNRF professors. Together you have had an enormous impact on science and society in Denmark. We at the foundation would like to convey our sincere compliments to all of you for the huge efforts that you and your teams have made in the name of science.

Together with the 2016 board and the DNRF team, we aim to continue leveraging groundbreaking research in Denmark and carrying on a positive dialogue with the Minister and Ministry, the universities, industry, the public sector, private and public research foundation and, most important, the scientists – young and old. Congratulations to Denmark and to the international scientific community for the wise decision to fund and secure the DNRF.

### **Professor Liselotte Højgaard**

Chair of the Board of the Danish National Research Foundation

### **Professor Søren-Peter Olesen**

Director at the Danish National Research Foundation



*Since the DNRF moved into its current premises, the secretariat and visitors have had the pleasure of viewing a large collection of several exquisite pieces of art on loan from the New Carlsberg Foundation. This publication shows a small selection.*

## THE DANISH NATIONAL RESEARCH FOUNDATION 1991-2016

PERSONAL REFLECTIONS  
BY KLAUS BOCK

### **The establishment of the DNRF**

During the 1980s, the Danish government established a long series of new initiatives to support Danish research groups. Among these initiatives were top down initiatives such as the Biotech programs I and II, the Material Science and Technology Development program, and more bottom up initiatives like the “superprofessors” and around 1990 the proposal to establish the Danish National Research Foundation (DNRF).

The latter two ideas were conceived under the Minister for Education and Research Bertel Haarder, who, at that time, had the responsibility for research and development in Denmark.

In 1990, the Danish Government privatized the insurance company “Statsanstalten for Livsforsikring.” The proceeds from this transaction, 2 billion DKK, were used to provide a trust fund for the DNRF, in order to make it independent of annual government budget negotiations.

The legal basis of the foundation was approved by the parliament on October 3, 1991. Soon thereafter, the first chairman of the board and the first Director of the foundation, Peder Olesen Larsen, took office and initiated the practical establishment of the foundation in collaboration with the appointed board of trustees.

### **The Centers of Excellence instrument**

Peder Olesen Larsen, among other things, started by visiting all research institutions in

Denmark to probe what opportunities such a new foundation could offer to the Danish scientific community.

The result of these investigations was the creation of the Centers of Excellence instrument which has been the foundation’s flagship ever since.

The first call for Centers of Excellence came out in 1992. 23 Centers of Excellence were established during 1993 and 1994 in all fields of science for a five-year period, committing about 825 million DKK.

### **The foundation’s governance structure**

At the end of 1997, the current Minister of Research and Information Technology, Jytte Hilden, initiated a change of governance structure for the foundation, in order to separate



the functions of the chairman of the board and the Director. This resulted in the appointment of the then rector at the University of Southern Denmark, Henrik Tvarnø, as chairman of the board, and starting in 1999, Professor Ole Fejerskov as Director of the foundation.

#### **An internationally composed board**

The DNRF board has become increasingly international since the foundation's establishment. This has been a conscious strategy on the part of the foundation, and was implemented gradually partially due to the fact that the board over the years has encouraged the nominating institutions to propose international profiles as new board members. In 1991, only one board member came from outside Denmark, but since 2010, approximately half of the board members have been from abroad and the official language at board meetings is now English. This had the further advantage that the number of times where board members had conflicts of interest in selecting new COE's were minimized.

However, having a chairman with no basic knowledge of the Danish research foundation landscape would be difficult. Therefore, the DNRF chairs have always been Danish. I followed Henrik Tvarnø (2004-2012), and was succeeded by Liselotte Højgaard (2013-present). Furthermore, it has also been beneficial for the foundation that the last Director and the current Director of the DNRF, Thomas Sinkjær (2007-2015) and Søren-Peter Olesen (2015-present), are both previous DNRF center leaders.

#### **The foundation's independence and challenges over the years**

The foundation's independence has been one of its foremost strengths over the years. When you are independent of the outcome of the yearly government budget negotiations, it allows for long term planning, for risk taking in funding decisions, and for agile adaption to structural changes – all things that have been significant in the DNRF's success over the years.

However, the independence has not been absolute. The DNRF is dependent on capital injections approximately every ten years. This fact combined with various revisions of the Danish research system have over the years challenged the DNRF's independence.

In my case as DNRF chair from 2004, I stepped right into this challenge. In the research political processes at the beginning of 2002 the fate of the foundation as an independent entity was at stake in the process of reorganizing the whole research council system. However, the first independent international evaluation of the foundation from 2003 demonstrated that the Center of Excellence model had proven to be very effective in generating breakthrough's in all fields of science. It was therefore decided politically in the revision of the whole Danish research system from 2004 to continue the model with the DNRF as an independent entity.

In order to secure a new capital injection, a number of new initiatives and adjustments to the Centers of Excellence instrument were set in motion, many of them on the basis of the evaluation.

#### **Development of the Centers of Excellence instrument over time**

The DNRF has maintained a two-stage process for identifying new COEs over the years, but in the second step, in addition to international peer review, half-hour interviews with the potential candidates were introduced as part of the final selection process in 2006 and onwards. At the same time, the board decided to have regular calls approximately every second year, in order for potential applicants to plan when it would be most convenient for them to submit a proposal.

Furthermore, in connection with the midterm review for the renewal of existing COEs, the five-plus-five-year model was changed to a six-plus-four model in 2011. This was based on the experience that many centers were not taking

enough risk in the beginning because they wished to demonstrate that they had produced international publications after only three years, the point at which the midterm review had to start in order for the board to make a decision about continuing the center.

One of the hallmarks of the foundation's activities is the annual follow-up meeting, at which the chairman of the board, the Director, one or two board members, and staff from the foundation visit all of the Centers of Excellence annually.

In order to increase the networking opportunities for the DNRF center leaders as a group, the foundation has also introduced and still facilitates regular research management and communication courses.

### **Internationalization**

Internationalization has been a recurring theme in the DNRF's strategic deliberations over the years. At the annual follow-up meeting with the centers, the board has often encouraged the centers to recruit international Ph.D. students and post-docs.

Only 2 % of the public funding for research goes to the DNRF, but the share of the total number of international Ph.D. students and post-docs in Denmark has been between 10 and 20 % since 2009 with an increasing tendency. In the current Centers of Excellence 2/3 of the postdocs are international.

Another attempt to increase the foundation's international activities was initiated from 2005 and onwards with the introduction of schemes such as the Niels Bohr Professorships, NSF stipends and joint funding programs e.g. the China Centers.

### **Capital injections and financial governance**

The foundation introduced the above initiatives in order to follow the advice offered by the international evaluation in 2003, but also to convince the political decision makers that the Centers of

Excellence model and the long-term funding were sustainable and worked to the benefit of Danish international scientific performance.

The result was very satisfying because the Danish government decided, probably also in connection with its globalization strategy formulated in 2006, to provide the foundation with new funding of 3 billion DKK in the summer of 2008 and spring 2015. With this money, the foundation can continue to operate at an activity level of about the actual level of 425 million DKK annually until 2036.

Another condition for the new money was that the foundation should use the same overhead percentage as the rest of the public funding agencies, 44 %, which meant that about one-third of the new money would go to the institutions receiving the grants.

### **Latest evaluation and capital injection**

As mentioned above, the funding for the foundation's continued activity was secured in 2008 but only until the last 10-year call in 2015.

Therefore, the board and the chair, together with the Director, were again challenged with the task of raising new money for the foundation's continued activity after 2015.

Fortunately, independent evaluations were presented during these years. First was a report from Gunnar Öquist and Mats Benner in 2012, "Fostering Breakthrough Research: A Comparative Study." This report concluded that the establishment of the Danish National Research Foundation in 1991 and its performance over the next 20 years, often termed the "Danish miracle," had been a dominant factor in the excellent performance of Danish research compared to that of, e.g. Sweden. Furthermore, in 2012, the Danish government initiated an independent international evaluation, chaired by Wilhelm Krull from the German Volkswagen Stiftung. This evaluation unanimously concluded that the foundation has been "extremely successful" in fulfilling its mandate to support frontline basic research to the benefit of the



Danish society. At the presentation of the report, the current minister of research, Morten Østergaard, concluded: "If the Danish National Research Foundation was a football team, it would be Barcelona."

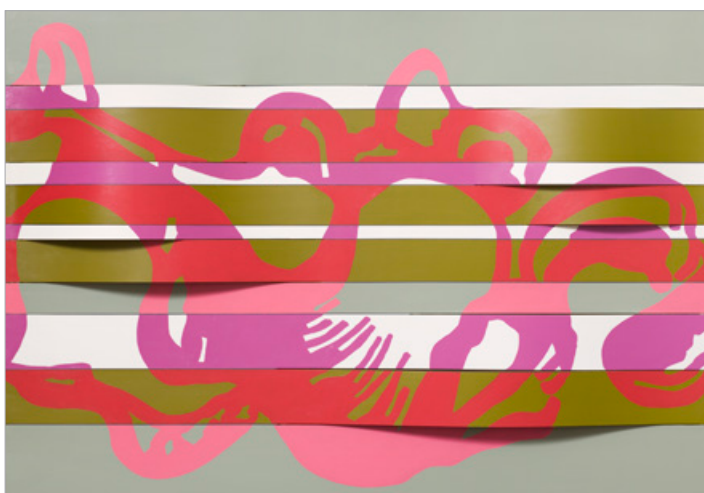
Based on these excellent reports, it was with great satisfaction that the foundation could again enjoy the government's trust that the DNRF's funding model was successful in supporting excellent research groups in Denmark, and consequently, the foundation received another infusion of 3 billion DKK in capital in order for the foundation to prolong its existence until 2036. The chair, the board, and the Director could once again conclude "mission accomplished."

Later, the Danish Council for Research and Innovation Policy (DFIR), in a 2016 report describing the links between research policy and national academic performance, also concluded that the Centers of Excellence initiative provided by the DNRF was a dominant factor in support of the excellent international performance of Danish science.

There will be challenges ahead, especially with obtaining renewed funding and maintaining the foundation's crucial independence from the annual government budget process. However, I am convinced that the foundation will continue to play an important role in the Danish research funding agenda for many years to come.

During my time as the DNRF chair, I always kept in mind the rules for success according to Arnold O. Beckman:

- There is no satisfactory substitute for excellence
- Absolute integrity in everything
- Everything in moderation including moderation itself
- Hire the best people and then get out of their way
- Don't take yourself too seriously



**Troels Aagaard (2006)**  
*Surface of sound*

Congratulations to Danish National Research Foundation as it celebrates its 25th anniversary! The Centers of Excellence support some of the best scientists to be their most productive. We welcome the collective efforts of the world's hardworking and creative scientists to better human lives.

David E. Clapham MD, PhD  
Vice President & Chief Scientific Officer,  
Howard Hughes Medical Institute



Danish National  
Research Foundation

Holbergsgade 14, 1

Copenhagen K, Denmark

First of all, my warmest congratulations on the occasion of the 25th anniversary go to you and your colleagues for the admirable work you are doing.

During the two and a half decades of its existence the Danish National Research Foundation has clearly demonstrated that it possesses all the ingredients it takes to be successful as a research funder of the highest caliber: a bold vision, a well-defined mission, a professionally designed mode of funding, and last but not least a competent and committed team that is determined to realize its potential creatively, research-friendly, and at the highest level of achievement. Just keep going!

With best wishes for the future  
and kind regards from Hannover.

Wilhelm Krull, Secretary General VolkswagenStiftung



Danish National  
Research Foundation

Holbergsgade 14, 1

Copenhagen K, Denmark



The DNRF is to be congratulated for its outstanding achievements during its first 25 years. Through its Centres of Excellence it has significantly enhanced the international impact of Danish research. DNRF has successfully shown what a granting organisation can achieve by emphasising the individual freedom to explore beyond disciplinary boundaries, by trusting scientists with long-term generous funding, and by recognising the importance of building creative research environments; all key factors to make research transformative, opening up new opportunities for mankind. DNRF is today an international blue-print for a successful funding organisation. With a focus on talented individuals with great ideas, DNRF has shown the way forward for the support of ground-breaking research.

Gunnar Öquist, former board member and former permanent secretary of the Royal Swedish Academy of Sciences



Danish National  
Research Foundation

Holbergsgade 14, 1

Copenhagen K, Denmark

It has become evident to many that the creation of the Danish National Research Foundation (DNRF) in 1991 played a key role in changing the dynamic of research development in Denmark.

The founders of the DNRF understood that ground-breaking research requires risk-taking and a long-term commitment to the support of frontier research in all fields. For that purpose, the organization serving the DNRF chooses its grantees as transparently as possible and gives them the necessary freedom and flexibility.

The ERC is based on the same proven principles and ambition at the European level, with the perspective of developing its impact in the area of innovation, where now Denmark stands as one of the leaders.

For that to happen we need to encourage the same far-sighted support for frontier research that Denmark has shown 25 years ago and use the Danish example as a milestone.

Professor Jean-Pierre Bourguignon,  
President of the European Research Council



Danish National  
Research Foundation

Holbergsgade 14, 1

Copenhagen K, Denmark

## DNRF BOARD AND DIRECTORS 1991-2016

### CHAIRS OF THE BOARD

**Peder Olesen Larsen**

Chair of the board

1991-1997

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**Henrik Tvarnø**

Chair of the board

1998-2003

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**Klaus Bock**

Chair of the board

2004-2012

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**Liselotte Højgaard**

Chair of the board

2013-

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**Karsten Laursen**

1991-1993

**Karin Hammer**

1991-1995

**Else Marie Bukdahl**

1991-1999

**Ole Hansen**

1991-1999

**Ulrik V. Lassen**

1991-1999

**Erik Nilsson**

1991-1999

**Gisela Sjøgaard**

1991-1999

**Aage Bøttger Sørensen**

1991-1999

**Niels Chr. Nielsen**

1993-2001

**Birgit Løgstrup**

1995-1999

**Elsebeth Budolfson**

1999-2001

**Else Marie Friis**

1999-2005

**Gudmund Hernes**

1999-2005

**Elsebeth Lynge**

1999-2005

**Lauritz Holm-Nielsen**

1999-2006

**Gretty Mirdal**

1999-2007

**Kell Mortensen**

1999-2007

**Bodil Norrild**

2001-2005

**Torben M. Andersen**

2001-2007

**Henriette Giese**

2005-2009

**Jens Rehfeld**

2005-2009

**Gunnar Öquist**

2005-2013

**Birte Svensson**

2005-2013

**Mogens Nielsen**

2006-2011

**Jörn Thiede**

2008-2011

**Kirsten Hastrup**

2008-2015

**Bo Ernø Honoré**

2008-2015

**Leena Peltonen**

2009-2010

**Eivind Hiis Hauge**

2009-2017

**Pirjo Nuutila**

2010-2013

**Svend Erik Larsen**

2012-2015

**Birgitte Possing**

2012-2015

**Christina Moberg**

2013-

**Bart De Moor**

2013-

**Eero Vuorio**

2013-

**Morten Overgaard Ravn**

2016-

**Minik Thorleif Rosing**

2016-

**Jesper Ryberg**

2016-

**Anne Scott Sørensen**

2016-

## DIRECTORS

### **Peder Olesen Larsen**

Director

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1991-1998

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### **Ole Fejerskov**

Director

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1999-2006

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### **Thomas Sinkjær**

Director

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2007-2015

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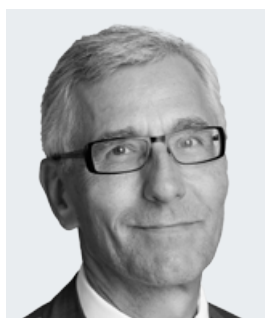
### **Søren-Peter Olesen**

Director

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2015-

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**John Kørner (2015)**  
*Adidas In Front II*

# FROM 1991-2016 THE DANISH NATIONAL RESEARCH FOUNDATION ESTABLISHED 100 CENTERS OF EXCELLENCE



### Søren Kierkegaard Research centre (SKC)

Professor Niels Jørgen Cappelørn



The Centre, 1994-2003, had two main objectives. 1) To produce a scholarly, annotated edition of *Søren Kierkegaards Skrifter* (55 vols, 22 appeared in the grant period, 33 through 2012). 2) To advance international Kierkegaard research, e.g. by educating junior scholars and publishing *Kierkegaard Studies* (18 vols, De Gruyter Verlag, Berlin & Boston).



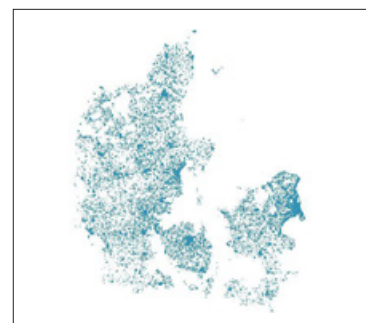
### The Danish Epidemiology Science Centre (DESC)

Professor Jørn Olsen



DESC was established as a collaborative centre with Copenhagen and Aarhus universities, SSI and the Bandian research centre in Guinea-Bissau.

Research was focused on cancer, obesity, unspecific vaccine effects, diet and fetal programming of diseases. The Danish National Birth Cohort with about 100,000 participants is still very productive.



### Centre for Labour Market and Social Research (CLS)

Professor Niels Westergaard-Nielsen



CLS succeeded to create a research environment with a lasting impact on a whole generation of empirical labour economists. The research was instrumental in changing Danish labour market politics becoming evidence based. In the process it played an important role in making Danish register based social science research internationally acknowledged and well connected.



### Theoretical Astrophysics Center (TAC)

Professor Igor Novikov



The goals of the center were 1) to develop a scenario for active galactic nuclei that encompasses a number of recently suggested processes 2) to obtain a qualitative understanding of the formation of individual galaxies as well as clusters of galaxies 3) to develop realistic models for the chemical evolution of galaxies.

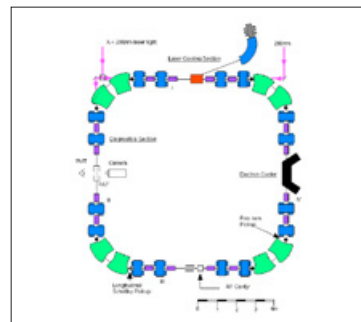


**Center for Atomic Physics (ACAP)**

Professor Jens Ulrik Andersen



The general theme of the research in Aarhus Center for Atomic Physics (ACAP) was study of the structure and dynamics of atoms and molecules, as reflected in their absorption and emission of light. Important research tools were small ion accelerators, storage rings and traps, combined with laser light or synchrotron radiation.



**Center for Atomic-Scale Materials Physics (CAMP)**

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Professor Jens Kehlet Nørskov



The general theme for the research at CAMP is the study of metallic nanostructures and their properties by a closely coupled experimental and theoretical approach.



**Centre for Basic Research In Computer Science (BRICS)**

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Professor Glynn Winskel



The research agenda behind BRICS – a DNRF Research Centre and International PhD School – was the theoretical foundation of computational systems based on the computer science disciplines algorithms, complexity theory, logic and semantics of computation, with applications in areas like software verification, data security and bioinformatics.

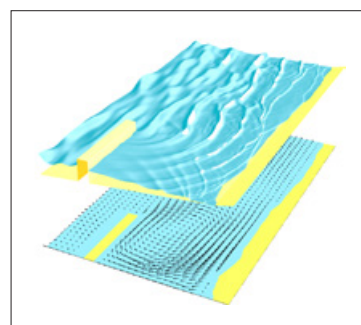


## International Research Centre for Computational Hydrodynamics (ICCH)

Professor Per Madsen



The main objective of ICCH was to conduct basic research in mathematical formulations and numerical techniques for hydrodynamics and transport processes relevant to the field of Coastal and Ocean Engineering. Important topics for the research were e.g. coastal dynamics; turbulent flow with free surface dynamics; stratified flow; ship and harbor dynamics and data assimilation.

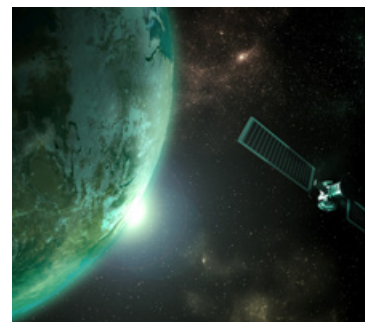


**Danish Centre for Remote Sensing (DCRS)**

Professor Søren Nørvang Madsen



The object of the DCRS was to integrate technological R & D in areas of remote sensing sensors, data processing, interpretation, and visualization, with Earth science studies. Additionally, the DCRS aimed to develop a limited scientific capability in Earth system science and global change research.

**Danish Lithosphere Centre (DLC)**

Head of center: Hans Christian Larsen



The lithosphere is the rigid layer making up the tectonic plates on top of mobile mantle below. DLC studied geodynamic processes related to the rupture of lithosphere as exemplified by continental breakup between Greenland and northwestern Europe. A huge, hot mantle plume provided the required weakening of the lithosphere to rupture at 56 Ma.

**Danish Centre for Experimental Parasitology (CEP)**

Professor Stig Milan Thamsborg



The Centre's research led to a new understanding of the population dynamics of parasitic helminth infections in pigs, serving as models for human and zoonotic helminths. Outcomes included mother-offspring relationships, interactions between helminths and diet, and helminth immunomodulation. These unique results pave the way for dietary interventions against parasites, better control, and potential therapeutic use of helminths in human inflammatory disease.



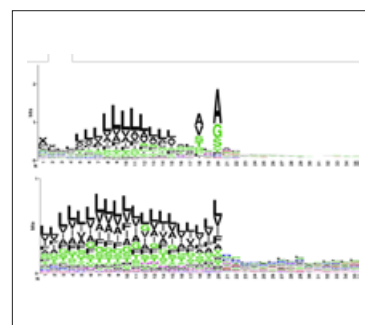
Photo: Lise-Lotte Christiansen

**Center for Biological Sequence Analysis (CBS)**

Professor Søren Brunak



The center works within bioinformatics – a research area that has emerged and gained importance due to the advent of large data sets produced by massively parallel experimental techniques in biology and medicine (e.g. DNA and protein sequencing). A premier activity has been machine learning methods, where data are used to create algorithms by “training”.

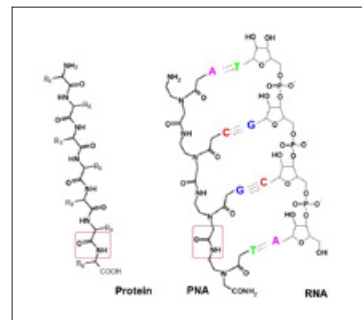


### Centre for Biomolecular Recognition

Professor Peter Nielsen



Center for Biomolecular Recognition focused on nucleic acids, and specifically on the artificial DNA mimic peptide nucleic acid (PNA), its properties and applications in molecular biology and biotechnological tools as well as in gene therapeutic drug discovery. The center was also very active in the area of sequence specific recognition of double stranded DNA.



### The Copenhagen Muscle Research Center (CMRC)

Professor Bengt Saltin



The main objective of CMRC was to unravel the signal interaction that secures a proper match of oxygen and substrate supply to the demands of skeletal muscle at rest and when used.



### Center for Sensory-Motor Interaction (SMI)

Professor Thomas Sinkjær



The overall aim of SMI was to establish an integrated biomedical engineering and neuroscience research environment at a high international level. The research activities at SMI concentrated on three inter-linked areas: Motor Control, Sensory Systems, and Neural Rehabilitation Technology. ([www.smi.hst.aau.dk](http://www.smi.hst.aau.dk))

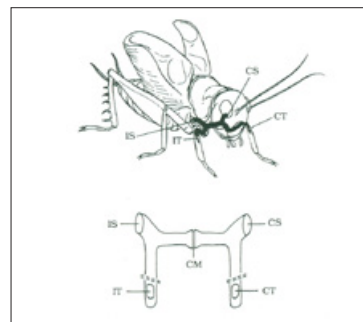


### Centre for Sound Communication (CSC)

Professor Axel Michelsen



A major part of the research was to introduce new methods at the borderlines between biology, physics and signal analysis. For example, the vibrations of animal ear drums were measured by analysing laser light reflected from ear drums (figure), and systems were built for determining the position of sounding animals (e.g. birds in the forest).



**Centre for Crystallographic Studies (CCS)**

Professor Sine Larsen



Investigations of the relation between protein structure and function by X-ray diffraction methods were the primary focus of the centre, an area now called structural biology. The research centered around enzymes involved in the bio-synthesis of pyrimidines and carbohydrate active enzymes.

**Centre for Enzyme Research**

Professor Kaj Frank Jensen



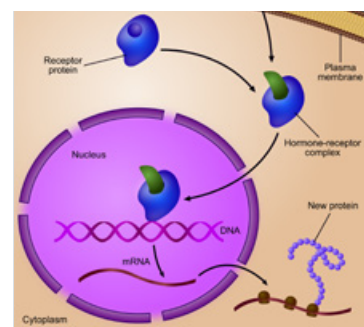
By studying the proteins of nucleotide metabolism the Centre for Enzyme Research aimed at providing a more detailed picture of nucleotide metabolism, and at gaining new insight into the area of enzyme specificity, catalysis, and allosteric regulation.

**Centre for Gene Regulation and Plasticity of Neuro-Endocrine Network**

Professor Lars-Inge Larsson



The purpose of the centre was to describe factors that control the expression of biologically active regulatory peptides by cells of the neuroendocrine system; gastrin cells and cloned rat islet tumor cells.

**Center for Semiotic Research (1993-1998)**

Professor Per Aage Brandt



The Center's development from structural and dynamic semantics (Greimas, Thom) to *cognitive semiotics*, through cognitive science and philosophy, was fueled by intense exchanges between research traditions represented by international top scholars visiting or participating in our conferences. Results include new models of language and meaning.

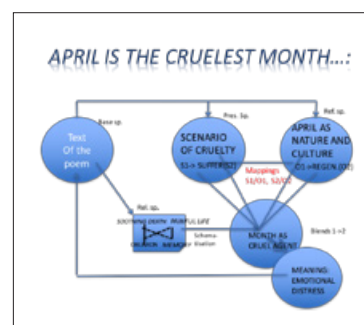


Figure: T. S. Eliot, The Waste Land

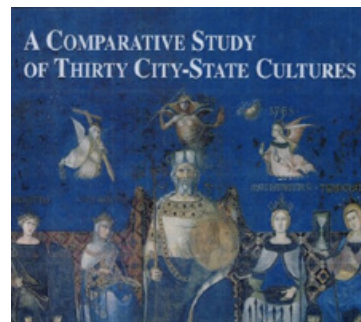


### Copenhagen Polis Centre (CPC)

Professor Mogens Herman Hansen



Ca. 3000 B.C.- ca. 1900 A.D. there were two types of state: macrostates each with a number of cities, and regions broken up into city-states forming a *city state culture*. We identified and described 37 city-state cultures. Our main task was to study the Greek city-state culture that in the 4<sup>th</sup> century B.C. comprised ca.1100 city-states (*poleis*).



### Centre for Maritime Archaeology at the National Museum of Denmark

Professor Ole Crumlin-Pedersen



The purpose of the centre was to contribute to a common cultural-historical conscience which involves the maritime perspective in accordance with the importance it has had in the past, especially in Denmark and Northern Europe.



Photo: Lars Kann Rasmussen  
Copyright: Vikingeskibsmuseet i Roskilde

### Economic Policy Research Unit (EPRU)

Professor Peter Birch Sørensen



The mission of EPRU was to improve the methodological foundations for the evaluation of economic policies. A main outcome of EPRU research was the construction of a computable general equilibrium model of the Danish economy which became the predecessor of the DREAM model which is now widely used in the economic ministries.

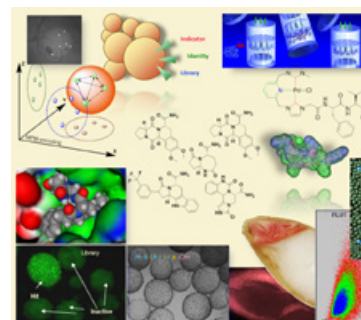


### Center for Solid Phase Organic Combinatorial Chemistry (SPOCC)

Professor Morten Meldal



The SPOCC center was hosted 1997-2008 at Carlsberg Laboratory, contributed to the fields of organic and biopolymer synthesis and to chemical biology in a most interdisciplinary manner. Obvious achievements of the center are those of "Click" chemistry, resin encoding technology, combinatorial chemical biology and a variety of novel solid phase organic chemistries.



**Center for Catalysis**

Professor Karl Anker Jørgensen



Chirality is the basis for the asymmetry in our body. Enzymes are the catalysts giving this asymmetry and have been used for over a century. Chiral molecules formed by asymmetric catalysis have expanded beyond enzymes. In the last decades of the 20<sup>th</sup> century, metal catalysts dominated; however, since the beginning of the millennium organocatalysis has been in focus. Center for Catalysis was among the pioneers in organocatalysis and has performed research, which have had impact in academia and industry.

**Centre for Plant-Microbe Symbiosis**

Professor Henriette Giese



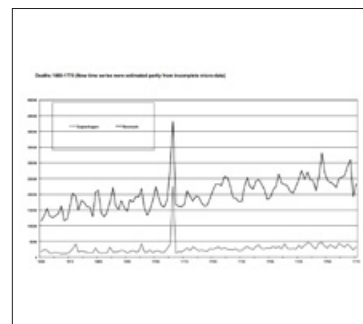
Research in the Plant-Microbe Symbioses aimed at the characterization of genes and processes involved in the molecular interaction between plants and micro-organisms exemplified by: Rhizobium/pea, mycorrhiza/pea and barley and Erysiphe graminis f.sp. hordei/barley. Study of the compound exchange controlling the establishment and maintenance of a symbiotic relationship formed the core of the research.

**Danish Center for Demographic Research**

Professor Hans Chr. Johansen



The key project of the center was research in aging to which were added studies in fertility and in historical demography (medieval and 17<sup>th</sup> to 20<sup>th</sup> century). Results from the research were several articles in international journals, a monograph on Danish Population History 1600-1939, seven Ph.D. degrees, and in cooperation with Statistics Denmark creation of a longitudinal data base of the Danish population.

**Danish Center for Earth System Science (DCESS)**

Professor Gary Shaffer



The main DCESS research themes were Climate System Stability, Role of the Ocean in the Climate System and Chemical and Biological Evolution of the Atmosphere and Ocean. Our approach has had a strong international legacy as shown by many publications with the DCESS Earth System model and by DCESS alumni as leading climate scientists around the world.



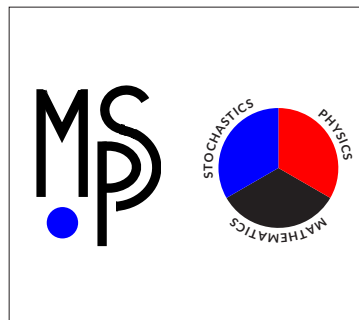
Photo: Kate Pepke Pedersen

### Network in Mathematical Physics and Stochastics (MaPhySto)

Professor Ole E. Barndorff-Nielsen



The focal point of the MatPhySto Centre was the interplay of Mathematics, Physics and Stochastics. The Centre was located at Department of Mathematical Sciences, Aarhus University, and included also researchers from the Universities of Copenhagen, Aalborg and Odense. It had far-ranging collaborations with leading researchers internationally.



### Center for Molecular Plant Physiology (PlaCE)

Professor Birger Lindberg Møller



Center for Molecular Plant Physiology studied the basic functions of plants with focus on photosynthesis, the plant cell wall and bio-active natural products. The research is now guiding development of robust multifunctional crop plants for the future and light driven synthesis of high value compounds in photosynthesis based cell factories.

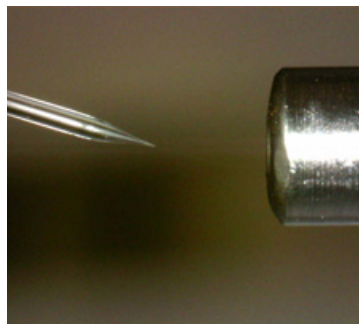


### Center for Experimental Bioinformatics (CEBI)

Professor Matthias Mann



The Center for Experimental Bioinformatics (CEBI) played a leading role in creating the field of mass spectrometry-based proteomics. Scientists at CEBI revolutionized the way in which proteins are analyzed in biology. Landmark publications from the center span from basic biology to applications in infectious diseases such as malaria.



### Center for Human-Machine Interaction

Professor Annelise Mark Pejtersen



The purpose of the center was to strengthen the academic quality of Danish Human-Machine research and to enhance the integration of approaches in the interdisciplinary field in order to improve the quality and innovation of design of human-machine interaction and interfaces for modern work places, which is enabled and required by the new technologies.



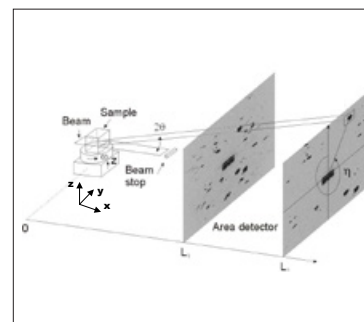


**Centre for Metal Structures in 4 Dimensions (M4D)**

Professor Dorte Juul Jensen, Professor Henning Friis Poulsen



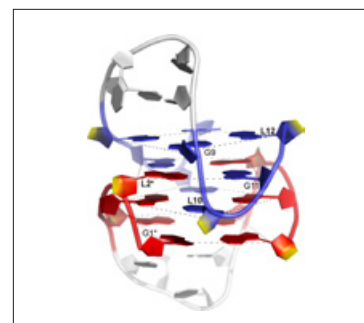
A technique for non-destructive 3D characterization of crystal-line materials was developed: 3DXRD. 3DXRD is now implemented on all major international synchrotron facilities. Based on 3DXRD data key metallurgical processes were for the first time visualized directly, leading to the formulation of new theories for the underlying physics.

**Nucleic Acid Center (NAC)**

Professor Jesper Wengel



The output of the Nucleic Acid Center was research at the international forefront which lead to novel discoveries and chemical technologies of substantial benefit to medical and biotechnological innovation.

**Centre for Applied Microeconometrics (CAM)**

Professor Martin Browning



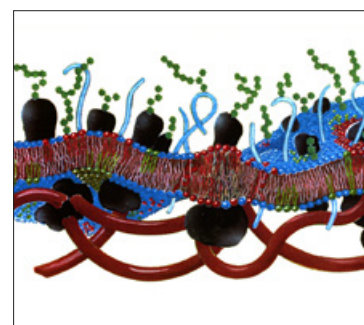
The distinguishing feature of CAM research in applied micro-econometrics is the focus on keeping a tight connection between economic theory and the analysis of micro-data. A major challenge in this regard is to properly account for heterogeneity and much of CAM's research explicitly addresses this issue. This involves the use of appropriate econometric techniques with a consequent tailoring of theory and econometrics to the data at hand.

**Center for Biomembrane Physics (MEMPHYS)**

Professor Ole G. Mouritsen



MEMPHYS is an interdisciplinary research center concerned with parallel experimental, computational, and theoretical research within the broad fields of physics and physical chemistry of soft interfaces and biological membranes, with focus on the relationship between membrane structure/dynamics and function.



### Center for Quantum Optics (QUANTOP)

Professor Eugene S. Polzik



The Quantum Optics Center - QUANTOP conducts experimental and theoretical research in quantum optics, quantum information science, quantum communication and quantum sensing. Launched by the DNRF, the Center now continues its research in Quantum Technologies with atoms, photons and nanomechanics funded by EU and US sources.

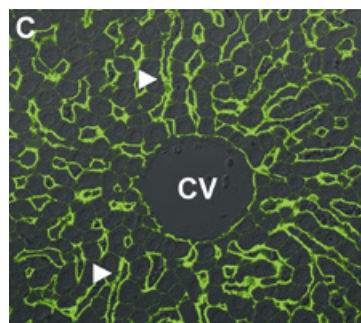


### The Water and Salt Research Center (W&S)

Professor Søren Nielsen



The Water and Salt Research Center focused on discovering molecular mechanisms involved in regulation of water/salt balance in health/disease, received 65 million DKK (DNRF), 151 million DKK (other grants), produced 450 papers, several patents, 70 PhDs, 37 one-year student projects, 5 new full professor and several assoc/assist professor positions.

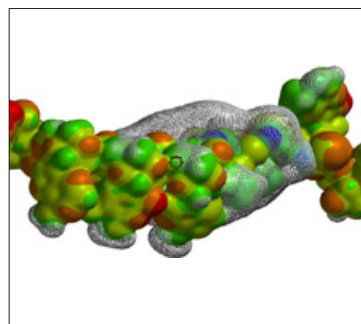


### Quantum Protein Centre (QuP)

Professor Henrik Bohr



Quantum Protein DG-Center, QuP, for studying quantum phenomena in protein/DNA using computers and spectroscopy. Achievements: Single molecule spectroscopy using SERS; QM simulation of Aquaporin for water transport; Chiral VCD spectroscopy of Transporter proteins; Large quantum calculations of DNA/LNA oligomers; articles, books, start-up companies.

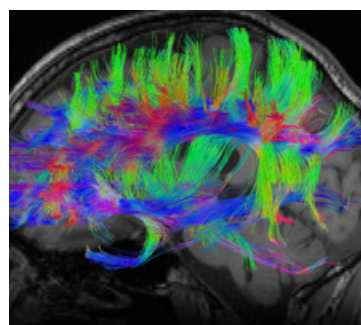


### Center of Functionally Integrative Neuroscience (CFIN)

Professor Albert Gjedde, Professor Leif Østergaard



Researchers at the center apply in vivo neuroimaging tools, biophysical and statistical models, and neurocognitive tests to study the brain and brain disorders. Scientists from the wide range of disciplines attempt to understand the structural, metabolic, and biochemical underpinnings of brain function and to identify substrates of brain plasticity.

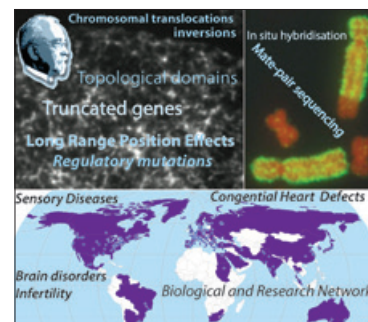


### Wilhelm Johansen Center for Functional Genome Research (WJC)

Professor Niels Tommerup



WJC identified new disease genes, genetic and mutational mechanisms, basic genome organisation and gene regulation, by systematic and worldwide mapping and integration of constitutional chromosomal breakpoints with functional and structural genomic data.



### Centre for the Study of the Cultural Heritage of Medieval Rituals

Professor Nils Holger Petersen



The *Centre for the Study of the Cultural Heritage of Medieval Rituals* explored the cultural reception of medieval church rituals, their resonances and resurfacings in post-medieval culture and the modern arts, as an important aspect of western cultural history, working in a range of historical disciplines under the overall centre perspective.



### Centre for Black Sea Studies (PONTOS)

Professor Pia Bilde Guldager



The focus of PONTOS was ethnic relations, cultural interaction, and economic interdependence in the Black Sea region in the period ca. 700 BC-AD 325, but with a main focus on the years ca. 400 BC-100 AD. Although the Black Sea region was viewed as a whole, particular attention was paid to the north and south coasts of the Black Sea region, i.e. of modern Russia, Ukraine, and Turkey.

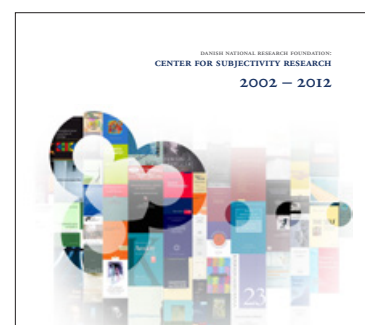


### Center for Subjectivity Research (CfS)

Professor Dan Zahavi



Center for Subjectivity works systematically on fundamental questions pertaining to the nature of self, the significance of consciousness, and the character of interpersonal understanding. It has for years promoted the dialogue between (the history of) philosophy and empirical science, in particular psychiatry.

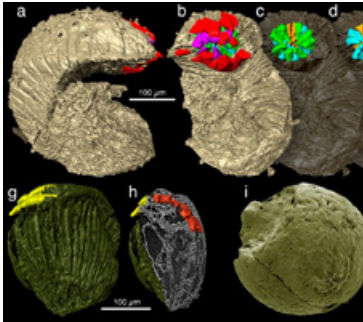


**Nordic Center for Earth Evolution (NordCEE)**

Professor Don Canfield



NordCEE was a multi-node center that explored modern microbes, animals, and their ecosystems, together with ancient rocks and fossils, to understand the coupled evolution of Earth's chemical environment and life through geologic time.



**Center for Individual Nanoparticle Functionality (CINF)**

Professor Ib Chorkendorff



The general theme of the research at CINF is the fundamental study of functionality of nanoparticles with focus on surface reactivity of relevance for catalysis. This involves three disciplines of catalysis: heterogeneous catalysis, electro-catalysis and photo-electro-catalysis used in connection with energy conversion and environment protection.

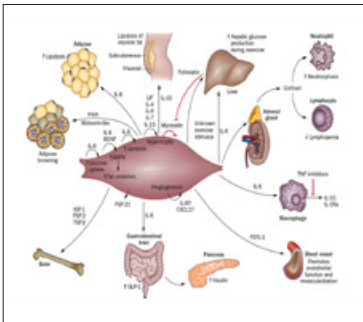


**Centre of Inflammation and Metabolism (CIM)**

Professor Bente Klarlund



CIM has identified skeletal muscle as an endocrine organ that produces and releases signal peptides, which we have named "myokines". The identification of hundreds of myokines provides a conceptual basis for understanding how muscles communicate with other organs such as fat, liver, pancreas and brain and why exercise is important to health.

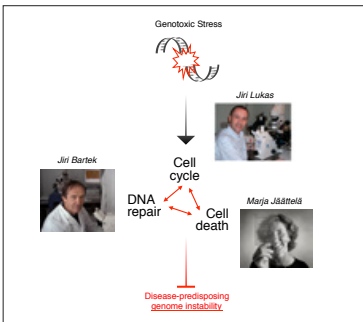


**Centre for Genotoxic Stress Research (GENOTOXIC)**

Professor Jiri Lukas



The Centre of Genotoxic Stress Research combines expertise in cell cycle regulation (Jiri Lukas), molecular pathology of DNA damage responses (Jiri Bartek), and cell death pathways (Marja Jäätelä) to elucidate fundamental mechanisms that guard the integrity of human genome against environmental or metabolic stress assaults.





**Centre for Social Evolution (CSE)**

Professor Jacobus J. Boomsma



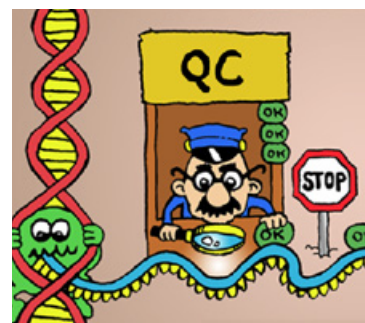
CSE studies general questions of natural cooperation and conflict. We use mostly ants, bees and termites and their symbionts to understand how advanced cooperation can evolve when the default settings of nature are competition and parasitic exploitation. Our approaches are interdisciplinary and cover many biological disciplines.

**Centre for mRNP Biogenesis and Metabolism (mRNP)**

Professor Torben Heick Jensen



Centre research aims to understand how the main products of our genes, the RNAs, are produced, functionalized and turned over. In other words: the births, lives and deaths of RNAs. We utilize basic molecular/structural biology approaches and advanced computational methods to build research projects with strong basic scientific impact, and relevance for biotechnological and biomedical application.

**Center for Insoluble Protein Structures (inSPIN)**

Professor Niels Chr. Nielsen



The aim of inSPIN has been unravelling the structure and function of proteins in native biological environment, including membrane proteins and amyloid fibrils associated with neurodegenerative diseases. The center has produced more than 1000 papers and educated more than 300 students.

**Center for Oxygen Microscopy and Imaging (COMI)**

Professor Peter R. Ogilby



Oxygen is an important molecule in many processes that occur on Earth. In the least, it plays key roles in the maintenance of life. The study of oxygen-dependent processes has long presented fundamental challenges. In the *Center for Oxygen Microscopy and Imaging*, we developed tools to elucidate oxygen's behavior in a wide range of systems.

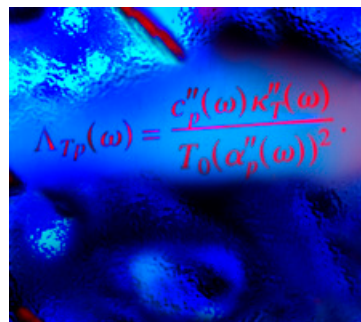


**Centre for Viscous Liquid Dynamics (Glass and Time)**

Professor Jeppe Dyre



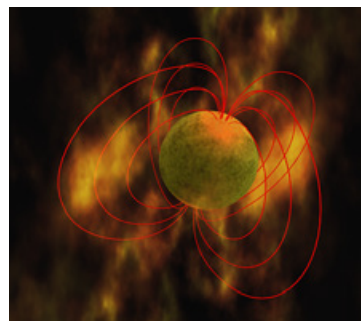
The research first focused on explaining glass-forming liquids' properties from experiments and computer simulations. In the process we discovered that half of all solids and liquids are simple by having so-called "isomorphs" in the thermodynamic phase diagram. This has vastly extended the research to including now solids and liquids in general.

**Dark Cosmology Centre (DARK)**

Professor Jens Hjorth



Among the most interesting results is our discovery of the first "afterglow" of a short gamma-ray burst in 2005. In 2013 we demonstrated that short gamma-ray bursts come from the collision of neutron stars, causing an explosion now referred to as a 'kilonova'. Such kilonovae are the most likely electromagnetic counterparts of gravitational waves. We have published approximately 1000 research papers in international journals, 27 of them in Nature or Science.

**Centre for Language Change In Real Time (LANCHART)**

Professor Frans Gregersen



At the LANCHART Centre we repeated earlier recordings from the 80s. This has given us an extremely detailed snapshot of the development of the Danish language community during the past 30 years. Dialects have been weakened to the point of extinction but new ways of speaking Danish, originating with young second generation immigrants, have developed.

**Centre for Textile Research (CTR)**

Professor Marie Louise Nosch



A new research field, *textile research*, was created by CTR, challenging academic research practice, bridging disciplines, incorporating artisans and conservators. Textiles are everywhere in our lives: they touch our skin and dress our world. Textiles stem from an age-old, global technology affecting the environment and expressing who we are.

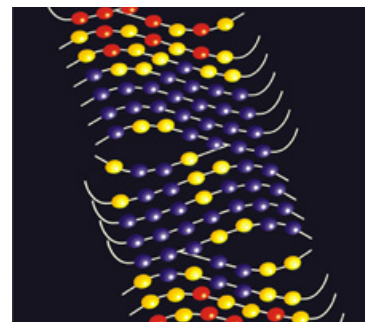


**Center for Models of Life (CMOL)**

Professor Kim Sneppen



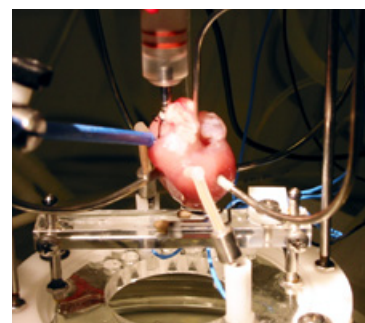
The Center for Models of Life study universality in life phenomena by means of predictive models of biological processes. Conceptual new inventions from center include a new theory of epigenetics, a framework for evolution of metabolism and its regulation, and a model for emerging diversity among competing sessile species.

**Danish Arrhythmia Research Centre (DARC)**

Professor Søren-Peter Olesen



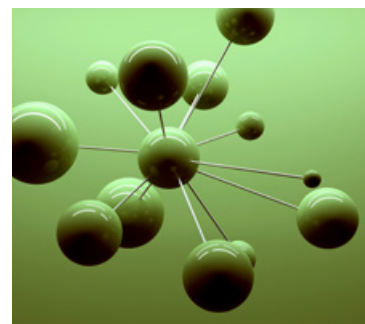
The center has clarified how specific molecular alterations in cardiac muscle signaling cause electrical instability and generate arrhythmias. The genetic background of the most common arrhythmia called atrial fibrillation has been delineated and a new pharmacological treatment paradigm developed.

**Center for Sustainable and Green Chemistry (CSG)**

Professor Claus Hviid Christensen



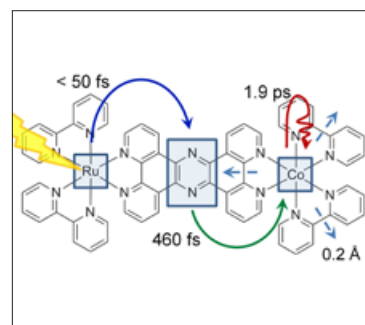
Center for Sustainable and Green Chemistry focused on providing the fundamental concepts needed to establish a completely new chemical industry based on renewable resources rather than on fossil resources as it is the situation today. This was done by developing strategies to identify likely key platform chemicals of tomorrow and by developing practical methods for manufacturing of selected bulk and fine chemicals, and potential energy carriers.

**Centre for Molecular Movies (CMM)**

Professor Martin Meedom Nielsen



Molecular Movies laid the foundations for building an atomistic picture of the processes involved in photoenergy conversion and charge and energy transport, by combining high level theoretical modelling with using ultra-bright, ultra-short pulses of X-rays to capture snapshots of the structural rearrangement in molecules and their surroundings.



**Center for Research in Econometric Analysis of Time Series (CREATES)**

Professor Niels Haldrup



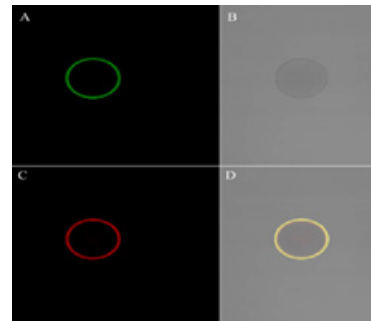
Center for Research in Econometric Analysis of Time Series, CREATES, is hosted at Aarhus University. The center conducts basic research in econometrics, particularly time series and financial econometrics. The research focuses on model estimation, economic and financial theory testing, and forecasting based on low and high-frequency historical observations.

**Centre for Carbohydrate Recognition and Signalling (CARB)**

Professor Jens Stougaard



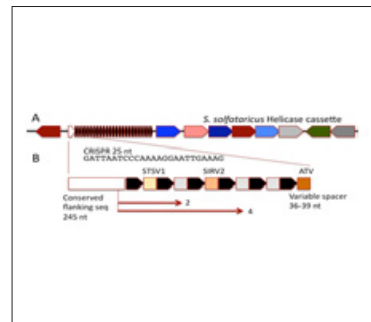
CARB determines the role of complex polysaccharides and receptors in the relationship between different cells and organisms. Cellular communication is important for understanding pathogenesis, immune responses, symbiosis and cell-to-cell signalling involved in the development and functioning of multicellular organisms.

**Centre for Comparative Genomics**

Professor Rasmus Nielsen



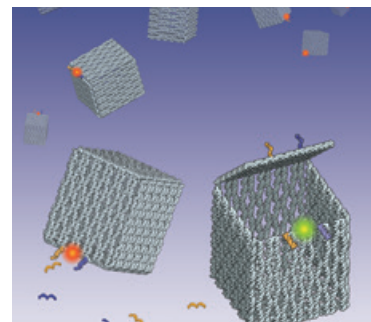
The Center for Comparative Genomics was established in February 2007 under the leadership of Rasmus Nielsen. The research was centered on five research areas all of which were dealing to some degree with exploiting the availability of enormous quantities of genome sequence data from a broad range of organisms.

**Centre for DNA Nanotechnology (CDNA)**

Professor Kurt Gothelf



We are using DNA, the information carrier of life, as a molecular building block that can be programmed to self-assemble into well-defined artificial nanostructures with amazing precision and complexity. The integration of other materials provides function to such designs for applications in biophysics, sensing, medicine, and molecular circuitry.



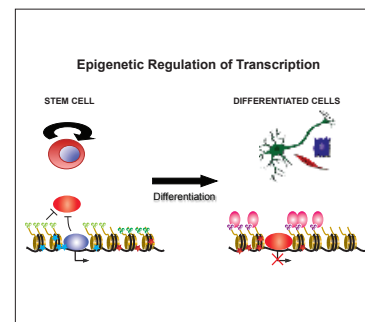


### Centre for Epigenetics

Professor Kristian Helin



In the Center for Epigenetics we study epigenetic mechanisms governing fundamental cellular processes such as proliferation, differentiation and cell fate determination. Moreover, we study the role of epigenetic regulation during normal development and how deregulation of epigenetic mechanisms contributes to human disease.



### Centre for Ice and Climate

Professor Dorthe Dahl-Jensen



The main activities are drilling and analysis of ice cores with the objective of understanding climate change in the past in order to improve our understanding of present and future climate change. We have led several international drilling projects that have led to comprehensive investigations into the climate of the past 128,000 years.



Photo: C. Morrell

### Center for Massive Data Algorithmics (MADALGO)

Professor Lars Arge



Motivated by the rapid increasing availability of massive data ("Big Data"), MADALGO focuses on advancing fundamental algorithmic knowledge in the area of massive data processing. The center has particular focus on the design of efficient algorithms that take the hierarchical memory organization of modern machines into account.



### Centre for Membrane Pumps in Cells and Disease (PUMPKin)

Professor Poul Nissen



PUMPKin investigates the microscopic pumps that maintain salt gradients, electrical potentials and lipid distributions across cell membranes. The research is highly interdisciplinary ranging from e.g. structural biology and electrophysiology to transgenic plants and mice. New insights into biotechnology and molecular medicine are also revealed.

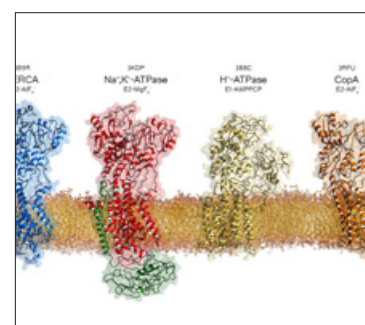


Figure: Oleg Sitsel

**Center on Autobiographical Memory Research (Con Amore)**

Professor Dorthe Berntsen



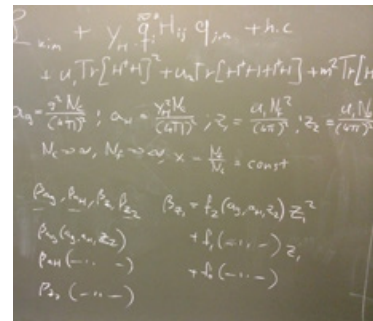
Autobiographical memory is a neurocognitive (brain/mind) system for consciously recollecting events in the personal past, by combining and extending more basic systems. We study autobiographical memory from a biological to a cultural level, across the life span from young children to older adults, during healthy cognition and in clinical disorders.

**90 Centre for Particle Physics Phenomenology & Origin Mass (CP3 Origins)**

Professor Francesco Sanino



The Centre for Cosmology and Particle Physics, CP3-Origins aims at unveiling the origins of the bright and dark side of the universe. We will also gain a deeper understanding of theories of fundamental interactions and their dynamics via analytical and numerical methods. These are the most ambitious goals in particle physics and cosmology.

**Center for Particle Physics (DISCOVERY)**

Professor Peter Hansen



The Discovery center has people colliding protons at the LHC machine, people probing cosmic photons and neutrinos with satellites and (ant)arctic observatories and people making theoretical sense of it all. The idea is to bring theory and different experiments together so as to better understand the matter and forces making up our Universe.

**Centre for Symmetry and Deformation (SYM)**

Professor Jesper Grodal



Symmetry is a fundamental notion in nature. Yet, its study is complicated since even small deformations of an object can fundamentally alter its symmetries. The center combines the mathematical disciplines of group theory, homotopy theory, and non-commutative geometry with the goal of understanding the mathematics behind symmetry and deformation.



**Center for Materials Crystallography (CMC)**

Professor Bo Brummerstedt Iversen



The Center for Materials Crystallography has focus on atomic structure based research, where strong competences in synthesis, characterisation and theoretical modelling are used to address key challenges in materials science. The center has special emphasis on pushing the limits of synchrotron and neutron crystallographic techniques

**Centre for GeoGenetics**

Professor Eske Willerslev



Photo: Mikal Schlosser

Researchers at the Centre for GeoGenetics are interested in understanding the processes that formed contemporary human genetic diversity and geographical distribution and how these events may have impacted the environment. The centre has produced more than 30 papers in the journals *Nature* and *Science* since its start in 2010.



Photo: Preben Hjort, Magus Film

**Center for Quantum Geometry of Moduli Spaces (QGM)**

Professor Jørgen Ellegaard Andersen



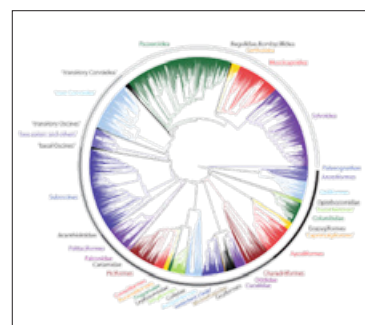
Centre for Quantum Geometry of Moduli Spaces (QGM) focuses its research efforts around the study of the quantum geometry of moduli spaces at the crucial interface between mathematics and theoretical physics, contributing to the mathematical underpinnings of contemporary and future topological physical theories and macro-molecular folding in microbiology.

**Center for Macroecology, Evolution and Climate (CMEC)**

Professor Carsten Rahbek



Life on Earth is diverse and exhibits dramatic patterns of variation in space and time. Research at the center takes on the grand challenge of answering one of the most fundamentally important questions facing science today: *what are the fundamental evolutionary and ecological principles and processes that generated the complex pattern of the distribution of life on Earth.*



### Center for Star and Planet Formation (StarPlan)

Professor Martin Bizzarro



We are a multidisciplinary research center exploring the origin of planetary systems by integrating cosmochemistry, astrophysics and astronomy. We hope to understand the circumstances enabling the formation of terrestrial-like planets in the Galaxy, including the preservation of water worlds like Earth, where life has existed for ~4 billion years.



### Centre for Medieval Literature (CML)

Lars Boje Mortensen



CML, based jointly at the Universities of Southern Denmark and York, aims to establish cross-disciplinary theoretical frameworks for the study of medieval literature from a fully European perspective. We draw on the methodologies of comparative literature and entangled history, considering a wide range of vernaculars as well Greek, Latin and Arabic.



### Center for Dynamic Molecular Interactions (DynaMo)

Professor Barbara Halkier



DynaMo is anchored within plant biology. We link molecular processes – pathway orchestration, regulatory networks, transport, metabolite sensing – across cellular, tissue to organismal levels. We take a pathway-centric approach to unravel universal principles enabling multicellular organisms to respond to myriads of developmental and external cues.



### Center for Permafrost Dynamics in Greenland (CENPERM)

Professor Bo Elberling



We link physical, (bio-)chemical and biological processes in arctic terrestrial ecosystems to quantify feedbacks from climate changes. We have established multi-disciplinary and large-scale field manipulations across Greenland. Combined with laboratory experiments, field observations have been incorporated into mechanistic and empirical models.



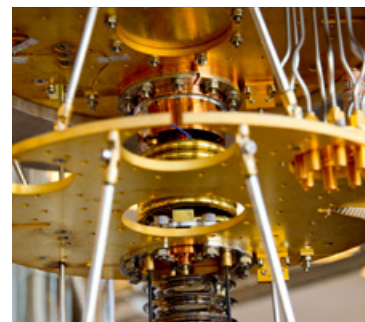


**Center for Quantum Devices (QDev)**

Professor Charles Marcus



The Center for Quantum Devices studies how to create, control, measure, and protect quantum coherence and entanglement in solid-state electronic devices. Once entanglement is brought under control, the technological harvest has the potential to revolutionize communication, information processing, and simulation of quantum mechanical systems.

**Center for Financial Frictions (FRIC)**

Professor David Lando



Center for Financial Frictions (FRIC) studies financial frictions such as transactions costs, leverage constraints, credit risk, illiquidity and asymmetric information. FRIC investigates the impact of financial frictions on the prices of financial assets, on monetary policy and on the design and regulation of financial markets.

**Center for Nanostructured Graphene (CNG)**

Professor Antti-Pekka Jauho



CNG develops new platforms for studies of basic science and applications based on new two-dimensional materials. The key idea is to control the electrical, thermal, and optical properties by imposing carefully designed nanoscale features to the pristine material. We use a combination of state-of-the-art experimental and theoretical techniques to reach our goal.

**Center for Geomicrobiology (CfG)**

Professor Bo Barker Jørgensen



The Center for Geomicrobiology studies life in the deep seabed which harbors a large part of all microbial cells on Earth. We aim to understand how microorganisms in this deep biosphere live under extreme energy limitation. We explore their genetic and physiological properties and detect how they drive important processes in the geosphere.



Photo: Courtesy of Island Drilling Singapore Pte Ltd.

### Center for International Courts (iCourts)

Professor Mikael Rask Madsen



iCourts, Centre of Excellence for International Courts, researches international courts, their role in a globalising legal order and their impact on politics and society. The centre has produced groundbreaking results on how international courts through complex social and political processes gain authority and influence the fundamental interplay of law and politics.

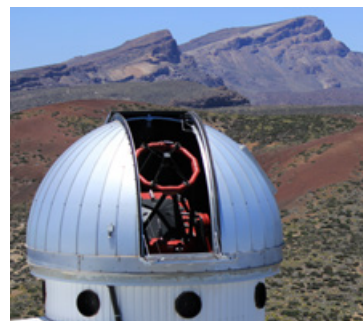


### Stellar Astrophysics Centre (SAC)

Professor Jørgen Christensen-Dalsgaard



Stellar Astrophysics Centre (SAC) focuses on the study of the properties of stars and their planetary systems. The research ranges from the study of the structure and evolution of the Milky Way Galaxy to the conditions for life on extra-solar planets and the prospects for detecting such life. A central aspect is the asteroseismic studies of stars, based on observations from space and from ground-based telescopes.

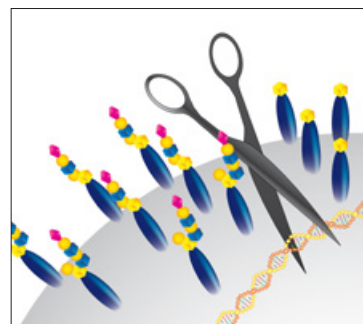


### Copenhagen Center for Glycomics (CCG)

Professor Henrik Clausen



Glycosylation is the third language of life, and is implicated in a myriad of critical biological processes - however we cannot simply read the glycome in all its complexity. The Copenhagen Center for Glycomics is cracking the code using a genetic approach, and developing novel in-silico tools to allow anyone to decipher this coded language.



### Center for Vitamins and Vaccines (CVIVA)

Professor Christine Stabell-Benn



Vaccines and vitamin supplements are designed to target specific diseases and deficiencies. However, CVIVA has discovered that these interventions have broader, so-called "nonspecific effects", significantly altering the recipient's resistance towards unrelated diseases. Understanding the non-specific effects can lead to major improvements in health.

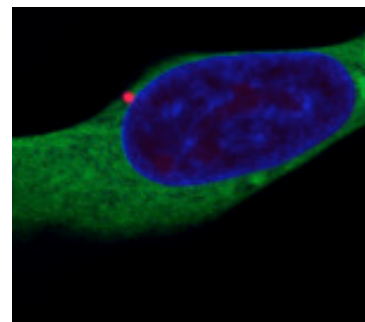


**Center for Chromosome Stability (CCS)**

Professor Ian D. Hickson



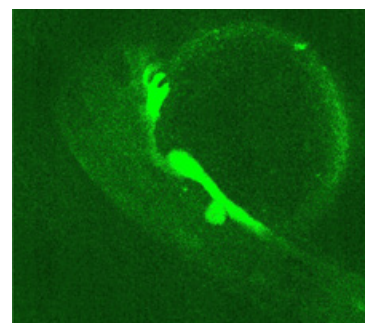
The Center for Chromosome Stability (CCS) aims to understand how genomic instability causes age-associated pathological conditions in humans, such as cancer, infertility and neurodegeneration. Many of our studies focus on regions of the human genome that are intrinsically unstable because of their unusual structure, which we term 'the enemies within'.

**Center for Stem Cell Decision Making (StemPhys)**

Professor Lene Broeng Oddershede



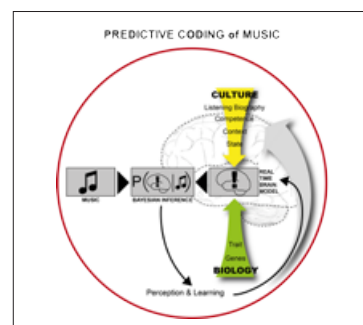
Stem cells can differentiate into any specialized cell and an understanding and control of stem cell differentiation holds enormous potential for regenerative medicine. StemPhys is an unconventional collaboration between stem cell biologists and physicists striving for understanding and controlling the mechanisms governing stem cell differentiation.

**Center for Music in the Brain (MIB)**

Professor Peter Vuust



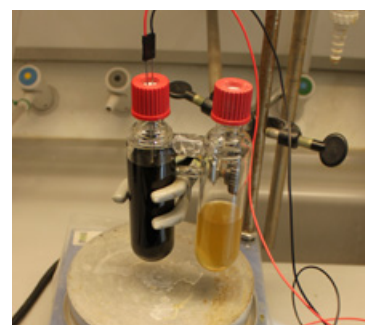
Center for Music in the Brain is an interdisciplinary research center at Aarhus University aiming to address the dual questions of how music is processed in the brain and how this can inform our understanding of fundamental principles behind brain functioning in general.

**Carbon Dioxide Activation Center (CADIAC)**

Professor Troels Skrydstrup



The objective of the Carbon Dioxide Activation Center (CADIAC) is to unveil fundamentally new science for the activation of CO<sub>2</sub>, thereby providing smart sustainable solutions for the exploitation of this molecule as a valuable C1-feedstock to high-value chemicals of industrial importance.



### Center for Urban Network Evolutions (UrbNet)

Professor Rubina Raja



Photo: Lars Svankjær

UrbNet is a groundbreaking archaeological research initiative exploring the evolution of urbanism and urban networks from the Hellenistic Period to the Middle Ages. UrbNet aims to compare the archaeology of urbanism from medieval Northern Europe to the Ancient Mediterranean and the Indian Ocean World, and determine how – and to what extent – urban networks catalysed societal and environmental expansions and crises in the past.

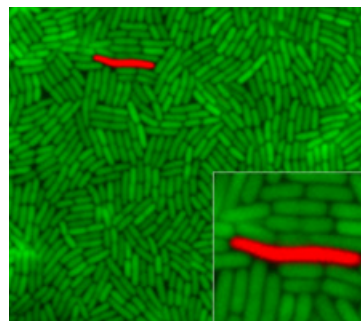


### Center for Bacterial Stress Response and Persistence (BASP)

Professor Kenn Gerdes



All bacteria produce stress-tolerant cells that can survive antibiotic treatment and thereby generate relapsing and chronic infections. The regulatory molecule, ppGpp, is the master regulator of this challenging phenomenon. The BASP Centre at UCHP studies how ppGpp controls bacterial drug-tolerance with the long-term aim to improve treatment procedures.

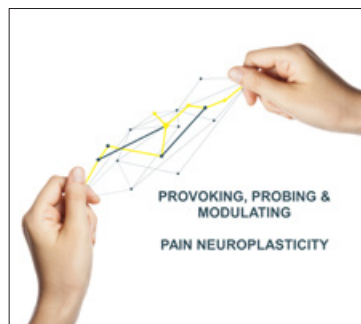


### Center for Neuroplasticity and Pain (CNAP)

Professor Thomas Graven-Nielsen



CNAP applies a biomedical engineering approach where new advanced pain provocation and probing platforms will be discovered and applied to reveal novel aspects of the human pain neuroplasticity. This will lead to experimental human models describing the unknown dynamic properties of pain neuroplasticity and subsequently how it may be modulated.



### Center for Intelligent Drug Delivery and Sensing using Microcontainers and Nanomechanics (IDUN)

Professor Anja Boisen



IDUN is a joined DNRF and VKR Center of Excellence, which explores nanosensors and microcontainers for oral drug delivery. New sensing principles are being discovered, explored, and applied in areas such as polymer degradation and drug release. Microcontainers are realized, studied and used for oral delivery of e.g. fragile drugs such as insulin.



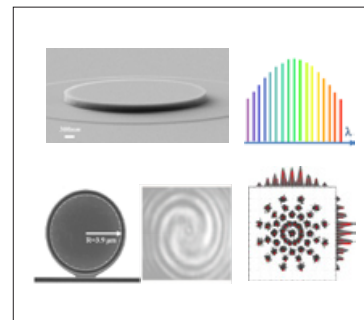


**Center for Silicon Photonics for Optical Communications (SPOC)**

Professor Leif Katsuo Oxenløwe



This centre explores new strategies for optical communications aiming for a future internet infrastructure, which will carry orders of magnitude higher data capacity, while being orders of magnitude more energy-efficient. This effort relies on photonic communication technologies over information theory to quantum communications.

**Center for Hyperpolarization in Magnetic Resonance (HYPERMAG)**

Professor Jan Ardenkjær-Larsen



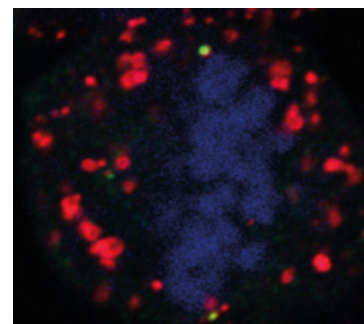
Center for Hyperpolarization in Magnetic Resonance is committed to addressing basic scientific questions of hyperpolarization by providing a theoretical and experimental basis of the magnetic resonance signal and optimal ways of extracting information about the system to enable new vistas in medicine, biology and chemistry.

**Center for Autophagy, Recycling and Disease (CARD)**

Professor Marja Jäättelä



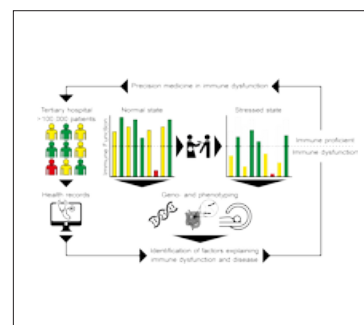
CARD combines complementary expertise to elucidate the orchestration of cellular energy balance, damage control, autophagy and recycling with focus on signaling pathways regulating these processes and their crosstalk with pathways controlling cell survival and malignant transformation.

**Center for Personalized Medicine Managing Infectious Complications in Immune Deficiency (PERSIMUNE)**

Professor Jens Lundgren



PERSIMUNE aims to identify the factors explaining the variation in risk of infectious complications among patients with immune dysfunction, in order to personalize management. The centre collects nationwide health care data and use state-of-the-art technologies for evaluation of host genetics, the microbiome, immune phenotyping and imaging.





**Marianne Grønnow (2013)**  
*Flora Danica*



**Morten Schelde (2013)**  
*Flora Danica*

## DANISH-CHINESE RESEARCH CENTERS

In collaboration with the National Natural Science Foundation of China (NSFC), the DNRF has established a joint program that funds Danish-Chinese research centers. This cooperative effort was established in 2005 and, since 2008, has given rise to 10 Danish-Chinese research centers.

### CENTERS ESTABLISHED IN 2008/2009

#### **Danish-Chinese Centre for Proteases and Cancer**

Danish leader: Professor Peter A. Andreasen, Aarhus University

Chinese leader: Professor Mingdong Huang, Chinese Academy of Sciences

#### **Danish-Chinese Centre for Self-Assembly and Function of Molecular Nanostructures on Surfaces**

Danish leader: Professor Flemming Besenbacher, Aarhus University

Chinese leader: Professor Chen Wang, National Center for Nanoscience and Technology

#### **Danish-Chinese Center for Molecular Nano-Electronics**

Danish leader: Professor Thomas Bjørnholm, University of Copenhagen

Chinese leader: Professor Yunqi Liu, Institute of Chemistry, Chinese Academy of Sciences

#### **Danish-Chinese Centre for Nanometals - Bridging the Length Scales**

Danish leader: Dr. Techn. Dorte Juul Jensen, Risø DTU National Laboratory for Sustainable Energy

Chinese leader: Professor Ke Lu, Institute of Metals Research i Shenyang

#### **Danish-Chinese Centre of Breast Cancer Research**

Danish leader: Professor Nils Brünner, University of Copenhagen

Chinese leader: Professor Huanming Yang, Chinese Academy of Science





Denmark



China

**CENTERS ESTABLISHED IN 2010/2011****Danish-Chinese Center for Intermediate Temperature Proton Conducting Systems**

Danish leader: Professor Niels J. Bjerrum, Technical University of Denmark

Chinese leader: Professor Wei Xing, Green Chemistry and Process Laboratory, Chinese Academy of Sciences

**Danish-Chinese Center for Organic-based photovoltaic cells with morphology control**

Danish leader: Professor Frederik C. Krebs, Risø National Laboratory for Sustainable Energy, DTU

Chinese leader: Professor Hongzheng Chen, Department of Polymer Science &amp; Engineering, Zhejiang University

**Danish-Chinese Center for IDEA4CPS: Foundations for Cyber-Physical Systems**

Danish leader: Professor Kim Guldstrand Larsen, Aalborg University

Chinese leader: Professor Huibiao Zhu, East China Normal University

**Danish-Chinese Center for Applications of Algebraic Geometry in Coding Theory and Cryptography**

Danish leader: Professor Tom Høholdt, DTU Mathematics

Chinese leader: Professor Hao Chen, East China Normal University

**Danish-Chinese Center for the Theory of Interactive Computation**

Danish leader: Professor Peter Bro Miltersen, Aarhus University

Chinese leader: Professor Andrew Chi-Chih Yao, ITCS, Tsinghua University



## LIST OF NIELS BOHR PROFESSORSHIPS

Aarhus University Research on the Anthropocene (AURA)

Niels Bohr Professor Anna Lowenhaupt Tsing, Aarhus University (University of California, Santa Cruz)

Center for Single Particle Science and Engineering (SPSE)

Niels Bohr Professor David Needham, University of Southern Denmark (Duke University)

Algebraic K-Theory and Arithmetic Geometry (AKAG)

Niels Bohr Professor Lars Hesselholt, University of Copenhagen (Nagoya University)

Earth System Petrology (NBP-ESP)

Niels Bohr Professor Charles Leshner, Aarhus University (University of California, Davis)

Centre for Cultural Psychology

Niels Bohr Professor Jaan Valsiner, Aalborg University (Clark University)

Astroparticle Physics Group

Niels Bohr Professor Subir Sarkar, University of Copenhagen (University of Oxford)

## LIST OF NIELS BOHR VISITING PROFESSORSHIPS

Niels Bohr Visiting Professor David E. Arnot, University of Copenhagen (University of Edinburgh)



Niels Bohr Visiting Professor Dale T. Mortensen, Nobel laureate, Aarhus University (Northwestern University)

Niels Bohr Visiting Professor Nicolai Reshetikhin, Aarhus University (University of California, Berkeley)

Niels Bohr Visiting Professor Christopher Frith, Aarhus University (University College London)

Niels Bohr Visiting Professor Catherine Martin, University of Copenhagen (John Innes Centre)

Niels Bohr Visiting Professor Hassan Aref, Technical University of Denmark (Virginia Polytechnic Institute and State University)

## LIST OF DNRF PROFESSORSHIPS

DNRF Professor Steen Rasmussen, University of Southern Denmark

DNRF Professor Jørgen S. Nielsen, University of Copenhagen

DNRF Professor John Couchman, University of Copenhagen



### THE NIELS BOHR PROGRAM

The Niels Bohr program has the distinct purpose of enriching Danish research communities with top-class researchers from abroad. This includes excellent international researchers, but the program is also an opportunity to “call” some of the outstanding Danish researchers who have chosen an academic career abroad back to Denmark.





**Erik A. Frandsen (2001)**  
*Lilies in Glazed Ceramic Vase*



**Agnete Therkildsen (1971)**  
*Two People*

## EVALUATION OF THE DNRF 2013



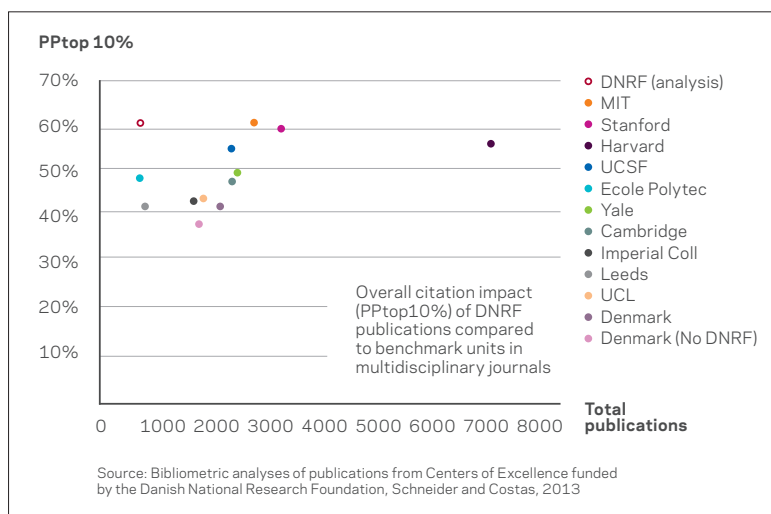
“ The high-trust modes of operation of the DNRF and its CoEs have proven to be extremely successful. (...) The evaluation panel therefore strongly recommends to enable the DNRF to continue its impressively successful operations and advises the Danish Parliament to take the necessary decisions for refunding the DNRF in such a way that the capital stock is sufficient to maintain its current annual budget of 400 mDKK in real terms for at least another 10 years.

Wilhelm Krull, chairman of the evaluation panel





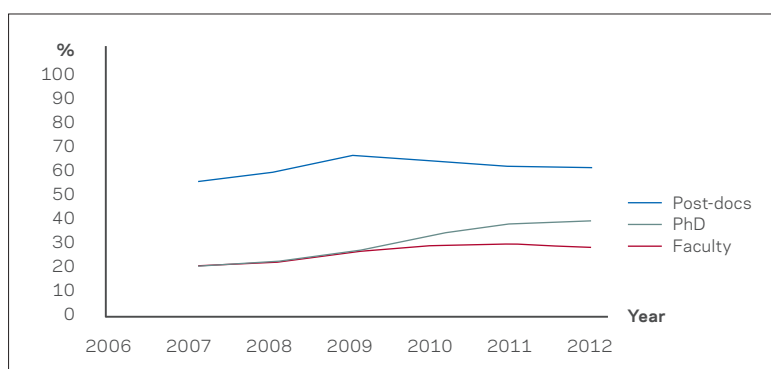
## MULTIDISCIPLINARY JOURNALS

**Competing with the best in the world**

The DNRf expects Centers of Excellence to do highly ambitious, original and potentially groundbreaking research.

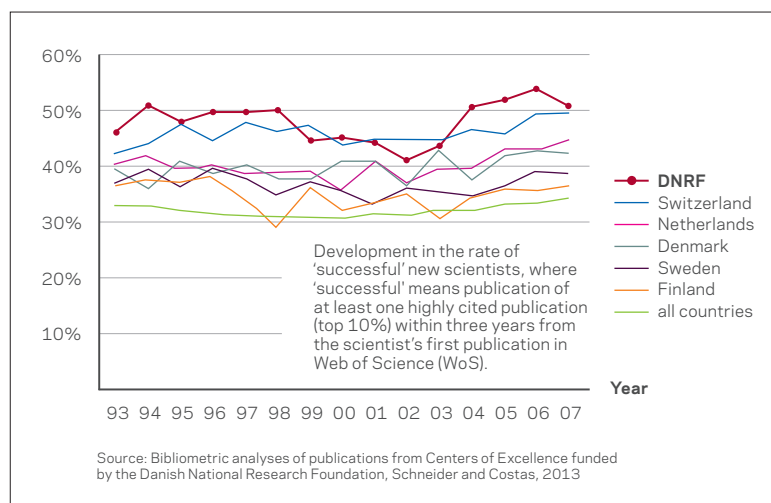
The evaluation showed that the CoEs do this at a world-class level.

The DNRf centers can compete with the very best research institutions in the world, including Stanford and MIT, when it comes to the impact of articles published in prestigious multidisciplinary journals such as *Science*, *Nature* and *PNAS*.

CENTER MEMBERS FROM ABROAD  
(PERCENTAGE OF TOTAL NUMBER)**International hubs**

The Centers of Excellence program has a strong international element. The centers are, to a large degree, international environments. Almost one-third of faculty members were foreigners in 2012, and more than 60% of all post-docs and 40% of Ph.D. students were from abroad.

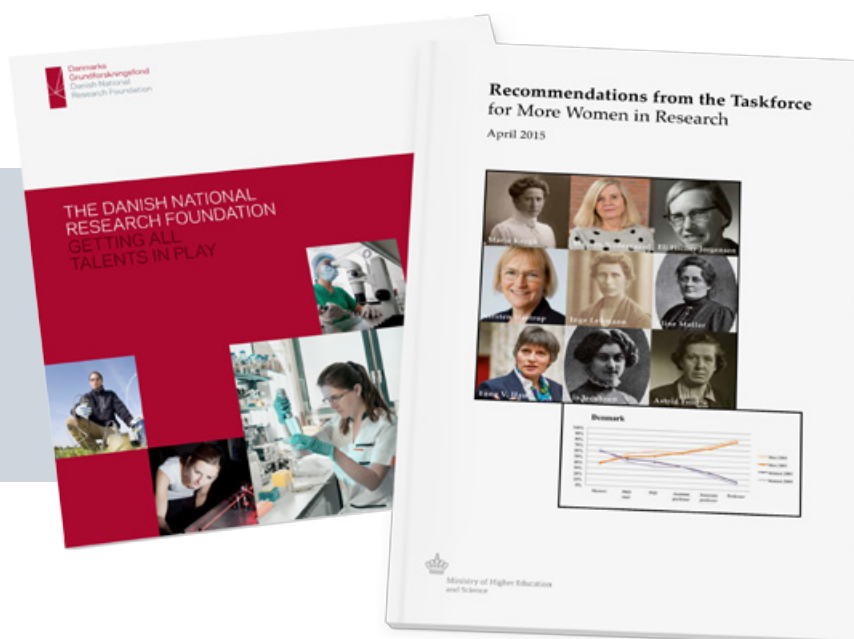
## SUCCESSFUL NEW SCIENTISTS

**Training sites for the next generation**

Not only are centers international training sites, they also set the standard for how exceptional research should be conducted. By serving as hubs for exceptional research, the centers are expected to provide optimal environments for training the next generation of first-rate scientists.

One in two scientists affiliated with a center is associated with at least one highly cited publication within three years of his or her first identified publication.

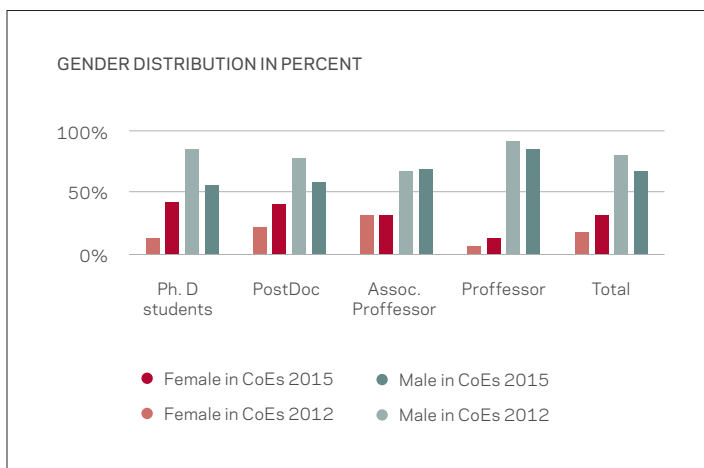
## GETTING ALL TALENTS IN PLAY



“ The challenge of the gender imbalance in research is not about getting more women to stay in research. It's about securing the best talents for research.

Professor Liselotte Højgaard, Chair DNRF





The gender distribution is based on submitted personal lists for DNRF Centers of Excellence. The figure compares gender distribution in 2012 to gender distribution in 2015. The graph shows an increase in the number of female researchers at CoEs during the time of which the DNRF has focused on the issue.

The Danish National Research Foundation regularly monitors the gender balance of the staff at its centers. An equal gender distribution will never be a criterion in the foundation's evaluation of proposals, but regular monitoring is important for continued attention to the issue.



Diversity is good for research because we humans and our society are characterized by diversity: different genders, different genetic compositions, different social and cultural backgrounds, etc. This is why we also react differently to medical treatment, and why we also have different perceptions of what constitutes a good society and a good life. Research used in decision making that affects us all must consider this diversity. Research that should benefit all of us must, of course, provide knowledge that can encompass all of us.

## ONE WEEK IN THE LIFE OF THE DNRF 2016

### EIGHT FOLLOW-UP MEETINGS AND A BOARD MEETING

During the third week of June 2016, the DNRF board visited seven Centers of Excellence and one Niels Bohr Professorship for follow-up meetings. The week ended with a board meeting on Friday, June 17.

#### **Why follow-up meetings?**

Follow-up meetings are a high priority. One or two board members, the chair and/or the Director and a research adviser visit each center annually to follow its development, learn about the CoE instrument, and, on occasion, give advice.

The points that the foundation generally wishes to discuss at follow-up meetings are the research, collaboration, external financing, dissemination and utilization of results, internationalization, researcher education/training, finances, administrative issues, the center leader's appraisal of the center as a whole, and the interaction with the host institution and the foundation, including any questions about embedment, etc.

The follow-up meetings are also of value to the centers because the meetings engage the entire center and thereby strengthen its identity and cohesiveness.

#### **Specific topics at follow-up meetings**

From one year to the next, specific topics are put on the agenda and discussed with all centers. In 2012, research integrity was such a topic, and the discussions with all centers led to the identification of some simple best-practice advice. In 2013, collaboration with and an emphasis on non-academic collaboration



*Chair Liselotte Højgaard and Director Søren-Peter Olesen on their way to follow-up meetings in Copenhagen.*

was on the agenda, and in 2014, the DNRF investigated reasons for and possible ways to correct the gender imbalance in research as the special topic at follow-up meetings.

Each year, the DNRF brings the knowledge it has gathered during the follow-up meetings into discussions with the research community at large at the DNRF annual meetings that are held in the fall.

#### **Post-doc mobility**

In 2015 the DNRF chair, board members and Director used follow-up meetings to address the challenge that approximately only 10-15 % of all post-docs will in the future end up in

“ The board values the close and running dialogue with the centers – this direct contact and knowledge of each individual center is one of the strengths of the DNRF. It is an opportunity to give advice or make adjustments if things go awry and at the same time offers insight into how the funding mechanism works and is best applied in different environments.

Professor Liselotte Højgaard, Chair DNRF

academia. During that year, the foundation talked to 300 post-docs who were currently affiliated with DNRF Centers of Excellence, and conducted a written survey of 253 post-docs who had been affiliated with DNRF Centers of Excellence between 2007 and 2014. The foundation was curious about a number of things: Why do many junior researchers undertake multiple post-doc positions knowing that, for most, it will not lead to permanent positions at universities? How can we design a system that will ensure maximum societal benefit from the massive talent pool that post-docs represent? Why isn't industry pursuing the talented junior researchers more aggressively? And what makes junior researchers happy job-wise?

The results are collected in the DNRF publication *The Post-doc Challenge*.

Following the year-long thematic focus on post-docs, the intersectoral mobility of junior researchers was put on the agenda for the DNRF's annual meeting. Here, it was discussed how to bring out the competencies that help to classify researchers into the public, private, and non-for-profit sectors, with an emphasis on implementing systematic mentoring programs.

To share the foundation's experience with an international audience, Director Søren-Peter Olesen published the *Nature* column *Keep it moving* on July 7th.

#### Board meeting number 148

At DNRF board meeting number 148, which ended this busy week in June, the board discussed possible new specific topics for next year's follow-up meetings. At the same meeting, the board was informed about the 173 proposals that had been received for the 9th round for Centers of Excellence. At the end of the meeting, the board met with the leaders of the centers that were about to expire to gain input from their experience. Thus ended a week in the life of the DNRF.





# FINANCES

## Seven billion DKK and 100 Center of Excellence

The state's sale of the Danish life insurance company "Statsanstalten for Livsforsikring" in the beginning of the 1990'ties led to the establishment of the Danish National Research Foundation (DNRF). Politically it was prioritized that the proceeds of two billion DKK from the sale should be invested in research, and in 1991 it was decided to establish the Danish National Research Foundation with a starting capital of the two billion DKK. The capital was invested in bonds with the initial objective that the return on investments should finance the grants. At the time the interest rate was approximately 10%, but the subsequent decrease in the interest rate entailed that the return on investments alone could not fund the established centers and future ambitions. Due to this structural condition the foundation was allowed to fund ongoing projects with its capital.

In 2008, the DNRF received a capital injection of 3 billion DKK via the Finance Act of that year which ensured that the foundation could continue its activities until 2026. In 2015, the foundation received another capital injection of 3 billion DKK allowing the foundation to continue its activities until 2036 with a capital of about 6 billion DKK.

With the capital injections and the return on investments the foundation has during the 25 years been able to fund Danish research with a total of 7 billion DKK. In October 2015 the foundation announced a 1 billion DKK application Round for New Centers of Excellence – the 9th application round in the foundations life-time. Throughout the past 25 years about 100 Centers of Excellence have been established. In addition to this, the DNRF has funded Niels

Bohr Professorships and engaged in joint funding activities.

The DNRF grants are large and long-term – 6 years with the possibility of a 4-year extension.

## Independent foundation

The Danish National Research Foundation is an independent foundation where the investments follow the placement rules set by the law. This model is needed due to the long-term perspective and has proven to work well since the foundation is independent of annual budgets or changing political focus. The independence ensures that the foundation can make long-term investments in research and thus create an optimal environment for outstanding research. The Danish National Research Foundation's share of public research funds have historically been around 2%.

With a portfolio of the fall 2016 of about 6 billion DKK and a policy to establish new Centers of Excellence every third year, the foundation will be running until at least 2036. We expect the success of the last 25 years to continue, and we foresee a new international peer review and a subsequent capital injection, so that the foundation can continue also after 2036.

The foundation has always followed a cautious investment strategy weighing the expected return with the associated risk. Since 1998, the foundation has evaluated the return on its investments against a benchmark that represents the strategic asset allocation decided by the board. Through this period of time the return after costs on the foundation's investment portfolio has been slightly above the benchmark.

FIGURE 1  
GIVEN AND PLANNED GRANTS

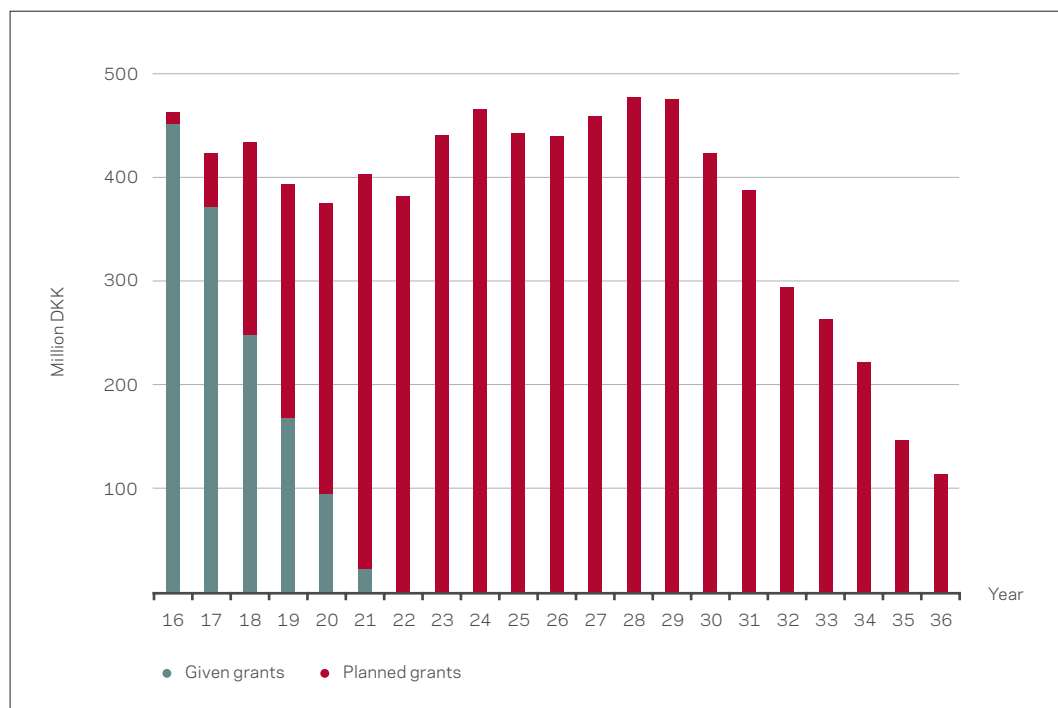
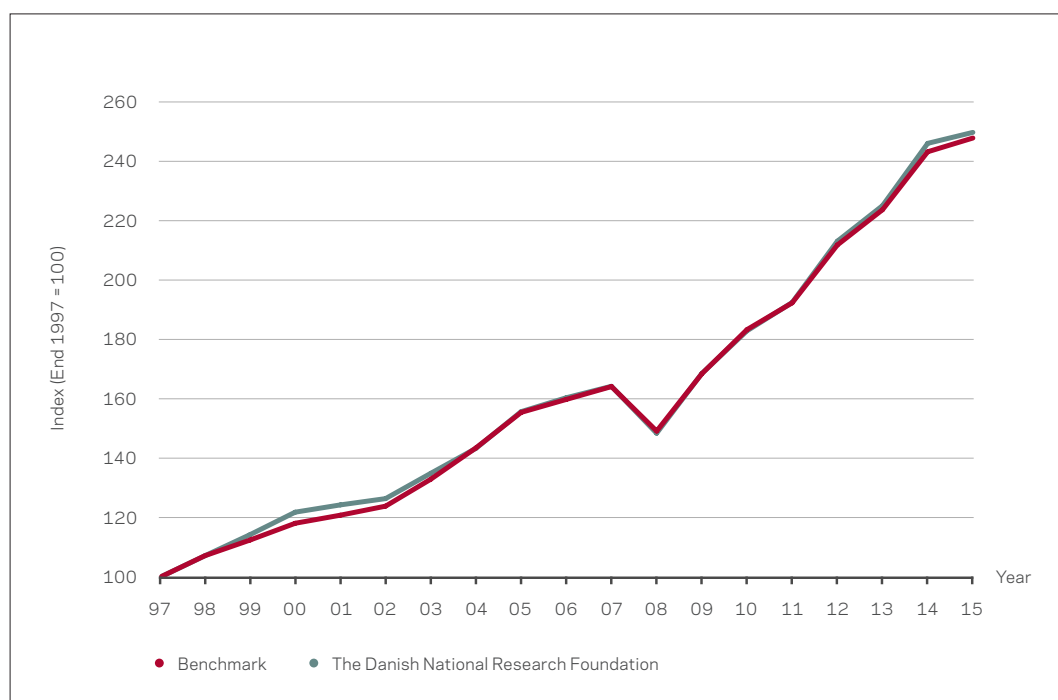


FIGURE 2  
RETURN 1998 TO 2015



**ISBN:** 978-87-989527-9-4

**Editors**

Gitte Tofterup Hansen  
Søren-Peter Olesen  
Liselotte Højgaard (in chief)

**Design**

Ineo Designlab / [www.ineo.dk](http://www.ineo.dk)

**Print**

We Produce / [www.weproduce.dk](http://www.weproduce.dk)

**Paper**

Tom&Otto  
Cover: 300 g, Pages: 150 g.  
Printed by an ISO 14001 certified printer.



**CLIMATE  
COMPENSATED  
PAPER**





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