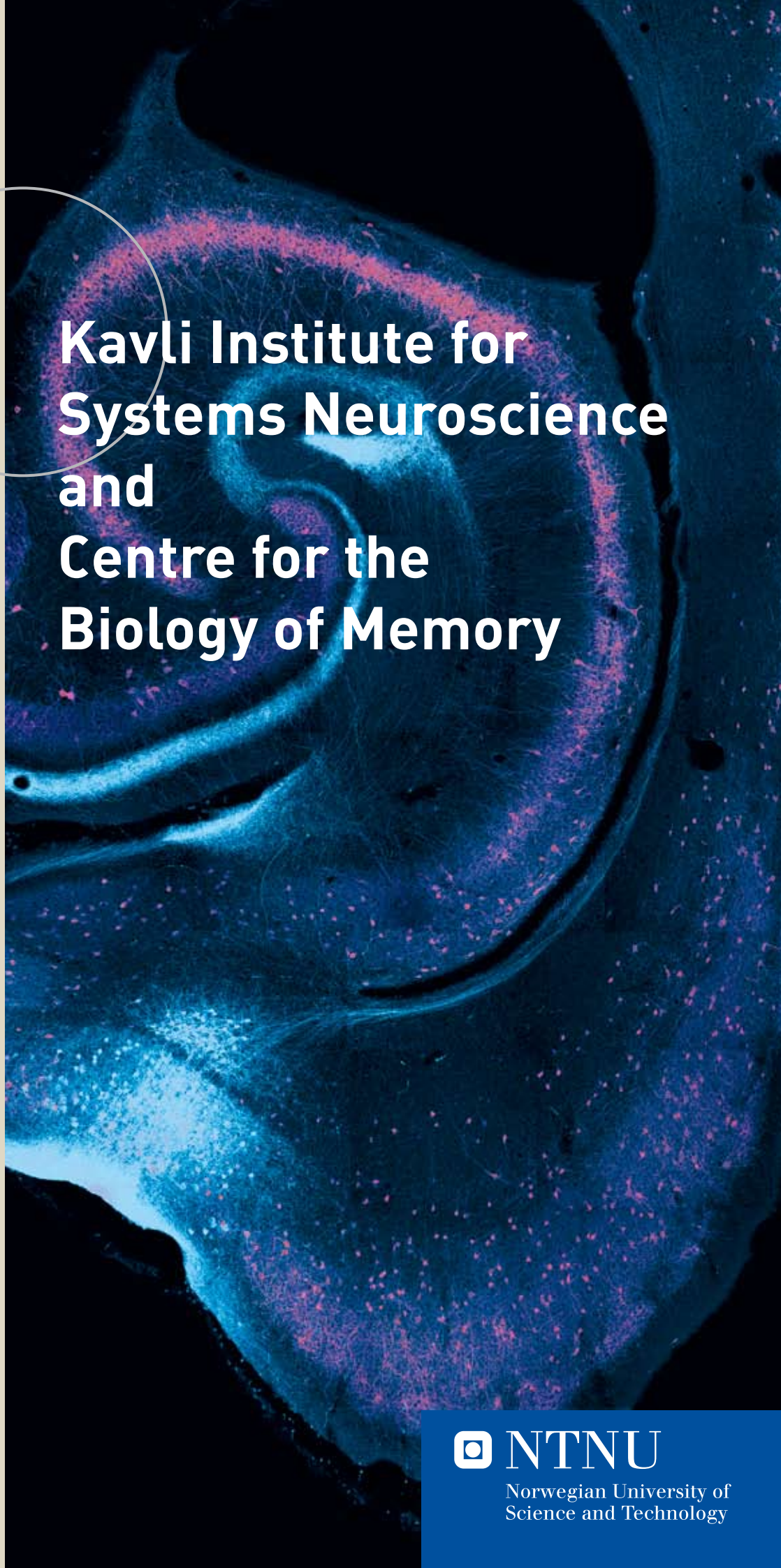
Kavli Institute for Systems Neuroscience and Centre for the Biology of Memory

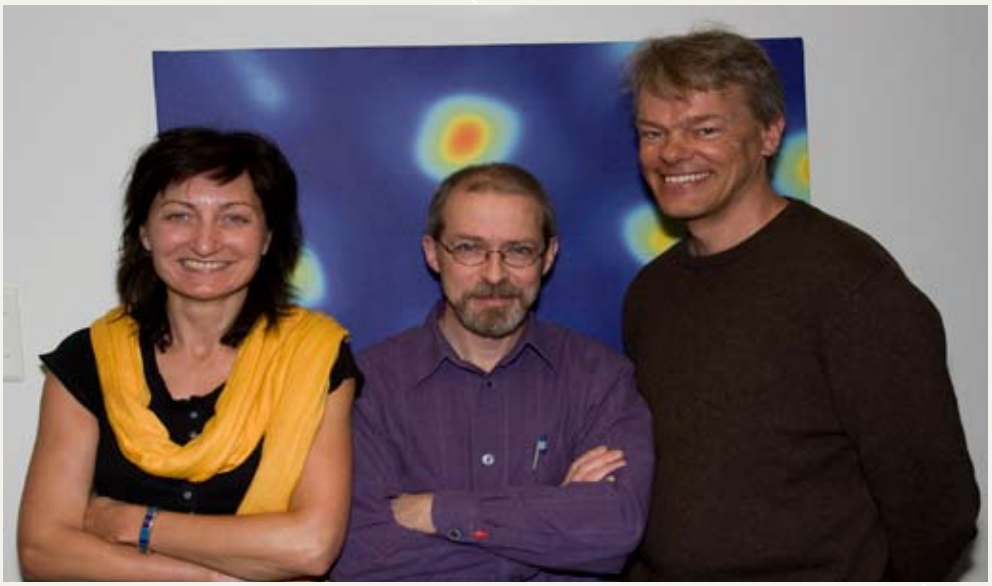
Annual Report 2007



Norwegian Centre of Excellence

NTNU
Norwegian University of Science and Technology

Group members 27 Mars 2008 (Photo: Gorm Kallestad/Scanpix)



Group leaders May-Britt Moser, Menno Witter and Edvard Moser (Photo: Raymond Skjerpeng/KI-CBM)

Front cover: Entorhinal innervation of parvalbumine positive neurons in the hippocampus. (Photo: Floris G. Wouterlood and Amber Boekel).

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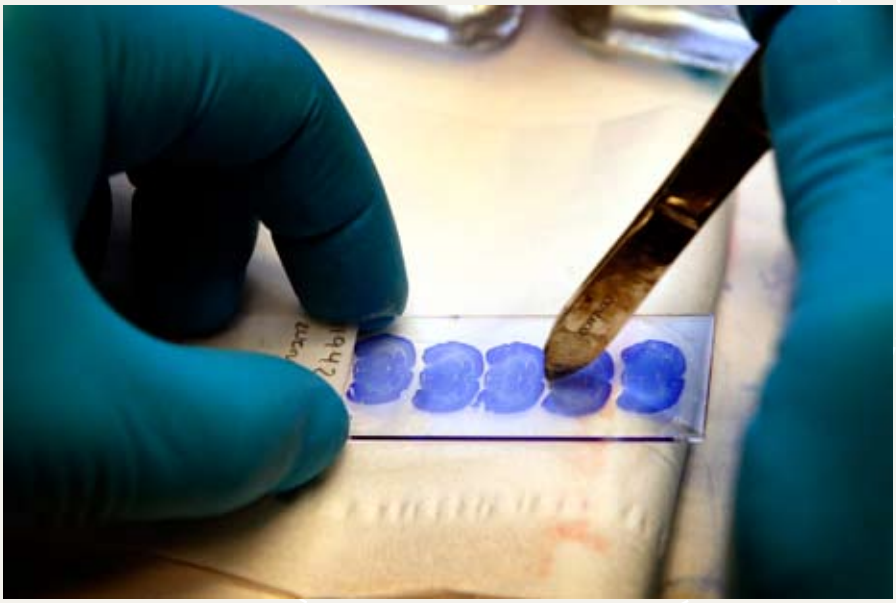


Brainslices stained with cresylviolet (Photo: Gorm Kallestad/Scanpix)

Recognition, expansion and change

In the next five years, we want to use the discoveries we have made to understand complex functions in the whole brain, say CBM and Kavli Institute directors Edvard and May-Britt Moser. (Photo: Geir Mogen/NTNU Info)

"2007 has been marked by recognition, expansion and change. The most important event is clearly that the centre became the 15th Kavli Institute in the world, which has involved quite a bit of recognition. Another important event has been the expansion of the permanent scientific staff, and we've also gone through with some important realignments", say May-Britt and Edvard Moser.

"The designation of the Kavli Institute for Systems Neuroscience is the most prominent recognition we have received to date. Most of the Kavli Institutes are at prestigeous universities in the United States, such as Harvard, Cambridge, Stanford, Yale, Caltech and MIT. We are the third Kavli Institute in Europe, along with the Kavli Institute of Nanoscience at the Delft University of Technology in the Netherlands, and the Kavli Institute for Cosmology at the University of Cambridge", emphasizes CBM director Edvard Moser.

"It's also been important for us that the permanent scientific staff expanded in 2007, with the hiring of Professor Menno Witter, who has now moved permanently to Trondheim. We have worked closely with him for several years, but the move means that our work will be that much more integrated. Witter is already working at full speed to build up a first-class and modern neuroanatomy laboratory," adds director May-Britt Moser. "The different groups at the centre complement each other quite well, and now we can work at a more in-depth level, and make important progress, while at the same time we've expanded our scientific breadth, and are a stronger specialist group."

A number of CBM's researchers have been awarded important honours and awards in recent years, which is a source of pride and optimism. "It's not just the enormous recognition that came from the centre being the only one in Norway that was awarded start-up funding from the European Research Centre (ERC), as a result of Stefan Leutgeb's project application. It's also that, by hiring Witter, we're laying the foundation to build bridges between basic research and clinical applied knowledge. Both Stefan and Menno represent knowledge and research that will contribute to making it easier in the future to diagnose and treat diseases such as Alzheimer's, epilepsy and other illnesses", predicts Edvard Moser.

The Research Council's Midterm Evaluation

The midterm evaluation of the CBM as a Norwegian Centre of Excellence gave the centre top marks. "Now we're halfway, and after five years it's natural to think about the time that has passed, and the next five years", muses May-Britt Moser. "The first five years have been marked by the development of our research group. We took as our starting point the mechanisms for memory

in the hippocampus. We began to realize early on that a sense of location couldn't just be the result of processes that take place in the hippocampus, so we therefore branched out into nearby cortical areas. We had to expand into the surrounding cortex, and in the entorhinal cortex we found a central part of the brain's spatial locater, namely a person's ability to figure out where he or she is located. That radically transformed our work. In the course of the first five years we've consequently made a discovery that has not only transformed our own work, but also the entire field. The understanding of place representation in the brain today is quite different than it was just a few years ago, because of the research that's taken place here at the centre," she emphasizes.

Understanding the whole brain

The centre's goal has consequently expanded and changed over the years. "With regards to the next five years, we now want to use the discoveries we've made to help in understanding the brain as a whole. To understand the workings of the neural network in general, we're using memory and spatial location as a starting point. The goal is that in coming decades, we use this knowledge to dedicate ourselves to also understand other cognitive functions, such as decision making and social interactions, because these abilities probably have a great deal to do with the brain's basic mechanisms. When all is said and done we want to understand things such as abstract thought and creativity", explain the two CBM directors.

Grid cells as a gateway

"The reason that we now can do this is that the mechanism for spatial location that we found, the grid cells, are easy to locate in the brain and have characteristics that are reliable and easy to measure. That means that we can use them as a gateway in understanding the general principles by which the neural network operates. Another important factor is that this is a phenomenon that is produced in the brain itself. In most of our sensory systems, you'll see changes in the signals that come in from the outside, and that are a reflection of the surroundings. These are adapted in the brain, while in grid cells, it is first and foremost "homemade" signals that are produced and adapted by the brain. That means that spatial location is a good model for examining how the brain works", explains Edvard Moser.

CBM researchers plan to use this model to understand complicated thought processes in the brain. "We'll do that in two different ways. The first is to take advantage of innovations in gene technology, to get a better handle on causal processes. The centre has now set up a virus laboratory where we will use harmless viruses to deliver genes to selected cell groups in the brain. By inserting genes into the target cells, these "delivery" viruses enable us to turn the cells on and off as we like. By turning cells on and off, we can find out which cell types have which functions.

The other approach we'll take is to use statistical analyses and modelling of activity in a large network. The data we get from research are so wide-ranging and variable that we will do well by running them through a computer model to understand what is possible and what is not in specific neural networks", the researchers say.

Expanded focus and social responsibility

CBM is a centre that is now pursuing a variety of directions, in as much as its various research efforts have grown. "Our fundamental focus is still on basic research. We will use memory and sense of location as a gateway to understand how the brain functions; that is the core of our work: we want to understand the normal processes in the brain. Nevertheless, our focus has been expanded to also include pathological conditions. Because the centre has more researchers, it means that it's possible for us to study more of the brain, such as the structure, as is being done by Menno Witter, and function and behaviour, as Stefan Leutgeb has begun to do", points out May-Britt Moser.

"Our research and findings have now come to the point where it's appropriate to build a bridge to clinical work. That won't change our basic approach to understanding the normal nervous system, but at the same time we're doing this to generate knowledge that will have more immediate applications. When basic research has clear consequences, it becomes our civic responsibility to work with applications based on what we have found out. That is a central element in Stefan Leutgeb's ERC proposal, which looks at what goes wrong in the brain as a result of Alzheimer's disease, for example. Additionally, Menno Witter is working with a research group at NTNU that wants to understand normal processes and pathological processes, such as are found in Alzheimer's disease and epilepsy", she adds.

"We would like to do our part to enhance the overall level of knowledge in the field, so we're particularly pleased to be able to arrange the Fridtjof Nansen conference on Neural Networks and Behaviour in June 2008. We'll bring together some of the best researchers working at the nexus of their various disciplines and neurosciences. There's been a great deal of interest in the conference already, and we have selected and invited top-shelf researchers. These kinds of conferences can contribute to lifting our overall understanding of the field. The best researchers from physiology, mathematics, physics, medicine and psychology whose focus is on neural processes will be gathered in a place where they won't only remember the conference because of its content, but because the location is so unique that their memories of the experience won't compete with other memories" says Edvard Moser, with a twinkle in his eye.

Not resting on their laurels

"This discipline is developing so quickly now that if a researcher wants to be involved with the next advances and change the field by contributing new knowledge, you have to do what you can to find ways to guarantee that you're asking the right questions. We also have to work on developing theories and models that explain why things work together the way they do. We have gotten a few laurels in 2007, but we're not going to rest on them. We don't have time!" say Edvard and May-Britt Moser.

KI-CBM begins its second period as a Norwegian Centre of Excellence

The Centre for the Biology of Memory (CBM) started its second period as a Norwegian Centre of Excellence (CoE) at the beginning of 2007, with financial support from the Research Council of Norway. The RCN contract was renewed after an international evaluation stated that the centre had "by all standards been exceptionally successful during the first period of operation".

The Research Council of Norway's midway evaluation of the Norwegian Centres of Excellence, which was made public in October 2006, included much praise for CBM's research and organization. CBM was one of 13 fields recognized as a Centre of Excellence when the Research Council first established the programme in 2002. In the midway evaluation, CBM and eight other centres were awarded top marks, or "exceptionally good". With the completion of the evaluation, CBM and other centres have now secured financing from the Research Council of Norway until 2013.

The midway evaluation's main conclusion about CBM was that the centre has had a major impact and developed into a major international centre for studies of the biology of memory. "The centre has had a remarkable series of high profile articles published in Nature, Science, Neuron and the Proceedings of the National Academy of Science. The centre's articles have had a very high impact, the quality is exceptionally high, and the quantity clearly satisfactory", the evaluation says.

The evaluation also observed that the centre's international collaboration has been very important both with regard to methodology and concepts. "The structure of the centre is somewhat unusual in that except for the two directors, the remaining principal investigators have been recruited from Europe and North America. They are international leaders in the different sub-disciplines within the centre's field", the evaluation report states.

The report also that stated that CBM had worked according to its original plan, which included milestones, but that the centre had also discovered grid cells – a major new finding that was not envisioned at the time of the application.

Norwegian Centre of Excellence

The scheme and the evaluation process
The Norwegian Centres of Excellence (CoE) scheme is designed to stimulate Norwegian research groups to set up centres devoted to long-term basic research. The intention is to raise the quality of Norwegian research and bring more researchers and research groups up to a high international standard. The purpose of the midway evaluation was to assess the scientific quality and performance of the individual centres in absolute terms and relative to the centres' original research plans.

The midway evaluation involved the preparation of extensive background material, an assessment of each centre by three international experts, and an overall evaluation made by an interdisciplinary, international evaluation committee chaired by Professor Sten Grillner at the Nobel Institute for Neurophysiology, Karolinska Institutet, Stockholm, Sweden. The overall impression was that the Norwegian CoEs have had a very positive effect on Norway's research environment in the disciplines for which CoEs have been established.

An efficient organization

The centre is run by the two directors in what appears a very efficient way, according to the evaluation. "The Mosers and their colleagues have established themselves as one of the leading research centres in memory research, which is one of the 'hottest' areas of brain research", the evaluation says. The report also stated that there is clearly a need for more space for the centre and for additional faculty.

The main conclusion from the international evaluation of the CBM was that the centre has had a major impact and has developed into a major international centre for studies of the biology of memory.
(Pfoto: Gorm Kallestad/Scanpix)

A privilege and an inspiration

"It's a privilege and an inspiration for NTNU's Faculty of Medicine to be the host faculty for the Centre for the Biology of Memory. The centre helps strengthen our Faculty's reputation, and puts our research activities on the world's map", says Stig A. Slørdahl, Dean of the Faculty.

"CBM's naming as the Kavli Institute for Systems Neuroscience in August, along with the award of Stefan Leutgeb's ERC Starting Grant in December 2007, are highlights that underscore the importance of having a Norwegian Centre of Excellence at the faculty. As a research group at the very forefront of international research, CBM is both a model and a beachhead for other groups in the Faculty. We have great expectations for CBM in the years to come, and look forward to continuing our strong co-operative effort and to new scientific breakthroughs", says Slørdahl.

Bettencourt prize finances new research

May-Britt and Edvard Moser received the Liliane Bettencourt Life Sciences Award in 2006 for their research and contribution to the establishment of the Centre for the Biology of Memory (CBM). In 2007, the majority of the prize money was used to pay for the postdoctoral fellowship for Rosamund Langston, who was recruited from the University of Edinburgh.

The prestigious Bettencourt prize of EUR 250,000 is each year awarded to younger European researchers with an international reputation. The prize is intended to support the work of a top-level European researcher under the age of 45, along with his or her team, in the field of biology or medicine.

The Bettencourt prize money was divided in 2007 to allow 80 per cent to finance Rosamund Langston's postdoctoral position. Langston's main research project concerns whether the grid cell system is innate and if the system is calibrated during growth. The Bettencourt money is also being used to study temporal codes in grid cells. The results from this project have attracted a great deal of international attention, and will appear in Nature in 2008.

Rosamund Langston with one of her rats. Rosamund is the postdoctoral fellow who was recruited from the University of Edinburgh with financing from the Bettencourt Prize. (Photo: Gorm Kallestad/Scanpix)

Grid cells on Scholarpedia

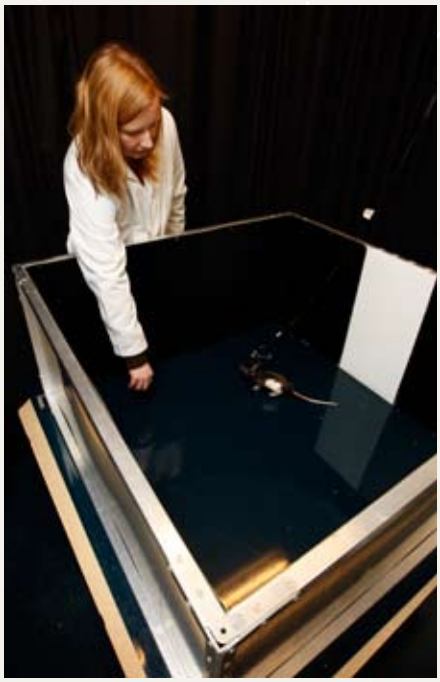
Edvard and May-Britt Moser were invited in 2007 to write about grid cells for Scholarpedia – the free scientific encyclopedia. Scholarpedia feels and looks like Wikipedia, which is the free Internet encyclopedia that anyone can edit. But one of the differences between Wikipedia and Scholarpedia is that each article in Scholarpedia is anonymously peer reviewed.

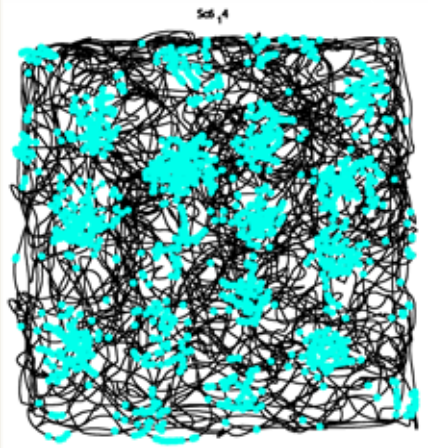
Both Scholarpedia and Wikipedia are powered by the same program, called MediaWiki, and both allow visitors to review and modify articles simply by clicking on the "edit this article" link.
However, Scholarpedia differs from Wikipedia in some very important ways:

- Each article is written by an expert (invited or elected by the public).
- Each article is anonymously peer reviewed to ensure accurate and reliable information.
- Each article has a curator – typically its author – who is responsible for its content.
- Any modification of the article needs to be approved by the curator before it appears in the final, approved version.

Herein also lies the greatest differences between Scholarpedia and traditional print media: while the initial authorship and review processes are similar to a print journal, so that Scholarpedia articles can be cited, they are not frozen and outdated, but dynamic, subject to an ongoing process of improvement moderated by their curators.

In Scholarpedia, every article has a person who takes care of its content and whose reputation becomes associated with this content, the curator. The job of a curator is to moderate revisions of an article, accepting those that are relevant and rejecting those that are not.
Scholarpedia curators are leading experts in their respective fields.
A grid cell – according to May-Britt and Edvard Moser's article in Scholarpedia – is a place-modulated neuron whose multiple firing locations define a periodic triangular array covering the entire available surface of an open two-dimensional environment. Grid cells are thought to form an essential part of the brain's coordinate system for metric navigation. They have attracted attention because the crystal-like structure underlying their firing fields is not imported from the outside world, but created within the nervous system. Understanding the origin and properties of grid cells is an attractive challenge for anyone wanting to know how brain circuits operate.





Grid cell recording in the entorhinal cortex: Top: Rosamund Langston training rat in open field environment. (Photo: Geir Mogen/NTNU Info) Bottom: Trajectory of the rat (black) with spike locations superimposed (blue) recorded by Jonathan Whitlock/KI-CBM.

KI-CBM becomes first Nordic Kavli Institute

The North American physicist, businessman and billionaire Fred Kavli designated the Centre for the Biology of Memory as a prestigeous Kavli Institute in 2007. The centre is one of only 15 designated worldwide, and the only one in Norway. The designation means that the Institute will receive approximately NOK 7 million in yearly support for the foreseeable future, along with enormous international recognition.

"The reason we chose CBM is because of their exceptional work in the neurosciences. In its field, this group is known the world over. Experts have said that CBM's work is some of the best that has been done in 25 years," said Fred Kavli to the Internet research newspaper Forskning.no.

Fred Kavli grew up in Eresfjorden in Romsdal and studied physics and engineering at the Norwegian Institute of Technology (NTH), as it was then known. In 1955 he went to Canada with his engineering degree and $300 in his pocket, and in 1958 started Kavlico Corporation in Los Angeles, in the United States. The company made sensors for planes, automobiles and space applications. The company was valued at more than $300 million in 2000, when Kavli sold the firm and used the proceeds to found the Kavli Foundation to support research in nanosciences, neurosciences and astrophysics. Fourteen Kavli Institutes have been founded in the last several years; Harvard, Cambridge, Stanford, Yale, Caltech, Peking and MIT are among the universities where Nobel Prize winners are working at Kavli Institutes. Fred Kavli is now known the world over as a billionaire philanthropist, and is often described as "the new Nobel". He serves on a number of influential boards and commissions, including the U.S. President's Council of Advisors on Science and Technology.

World-class research

The new Kavli Institute for Systems Neuroscience was formally dedicated on August 14, 2007, when then-Minister of Education and Research Øystein Djupedal signed an agreement with Rector Torbjørn Digernes at the Norwegian University of Science and Technology (NTNU) and with Fred Kavli. "It's always good to come home to Trondheim, but today it's even better," said Djupedal, who then expressed how proud he was that NTNU had become the newest member of the small, highly exclusive group of universities that hosts the Kavli Institutes.

"I am delighted to establish this institute, which we expect to make great future contributions toward further advancing the basic knowledge and understanding of the brain," said Fred Kavli. Noting that the institute is being established at his alma mater, Kavli added, "I think it's also

Fred Kavli (foreground), with Minister of Education and Research Øystein Djupedal (centre) and NTNU Rector Torbjørn Digernes (left) in a ceremony marking the establishment of the Institute. (Photo: Thor Nielsen/NTNU Info)

important to note that, while it is an added pleasure establishing this institute at a place that provided me many fond personal memories, that is not why this institute is being introduced here. It is because of the world-class neuroscience research being conducted by scientists such as Edvard and May-Britt Moser."
"The new institute will give the centre the best possible research opportunities, which will increase our ability to recruit and keep outstanding international researchers. Additionally, the creation of the institute represents substantial recognition and acclaim for the work being done at the Centre for the Biology of Memory," said an extremely pleased NTNU rector, Torbjørn Digernes.

Extremely selective

The Kavli Institute for Systems Neuroscience will be headed by Edvard and May-Britt Moser, who also will continue leading NTNU's Centre for the Biology of Memory. The centre and institute will coexist, with the intent of eventually considering a new centre that would be a part of the Kavli Institute.

"This has great significance in a number of ways. The Kavli Foundation is extremely selective in its choice of specialist groups, and the other institutes are the best in their field in the world. To be a member of this select group gives us enormous visibility and recognition. Additionally, support for the institute in principle lasts forever. That gives us confidence in terms of secure basic research funding, which makes it possible for us to undertake a little more risky research. That also means we can make a great deal of progress in areas where we might have to wait many years to get results," said Edvard Moser.

Developing new methods

The foundation donates start-up funds of approximately NOK 45 million to each new Kavli Institute. The intent is for the money to be invested, with the institute drawing on yearly dividends for research support. The Kavli Foundation also requires that the host university for the research group provide significant financial support. In that regard, both NTNU and the Ministry of Education and Research have promised to match the proceeds that the institute gets from its initial Kavli investment. In total, the research group will receive an annual amount of approximately NOK 7 million.

Among other efforts, the new Kavli centre will focus on a new method that uses the tools of molecular biology to turn brain cells on and off, which will make it much easier to determine what individual cells actually do in the brain. "This is a newly developed method that will probably revolutionize this field of research. Now we can devote ourselves to this fully. We will also work with simulations and models of the brain," said Edvard Moser.

THE KAVLI FOUNDATION

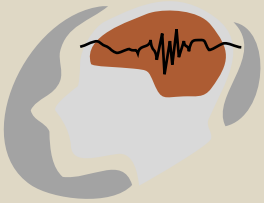
The Kavli Foundation

The Kavli Foundation supports scientific research, honours scientific achievement, and promotes public understanding of scientists and their work through an international program of research institutes, professorships and symposia in the fields of astrophysics, nanoscience and neuroscience. The Foundation also supports the Kavli Prize, which beginning in 2008 will recognize the world's outstanding leaders in astrophysics, nanoscience and neuroscience.

There are now 15 Kavli institutes worldwide dedicated to neuroscience, nanoscience, astrophysics or theoretical physics. The Norwegian institute is the fourth Kavli institute dedicated to neuroscience, joining the Kavli Institute for Neuroscience at Yale University, the Kavli Institute for Brain Science at Columbia University, and the Kavli Institute for Brain and Mind at the University of California, San Diego.

Fred Kavli (Photo: kavlifoundation.org)

Menno Witter becomes new member of KI-CBM



Professor Menno Witter began at the Centre for the Biology of Memory in September 2007 as a professor of neuroanatomy, although he was officially hired in the beginning of January. Professor Witter is quite pleased with his new position in Trondheim.

"The centre provides one of the world's best environments in which to do research on the hippocampus and parahippocampus and their relationships with other parts of the brain as a major substrate for learning and memory, so I feel honored and really fortunate to be part of the team. Having lived and worked in Trondheim now for almost half a year, it feels like I have been able to continue and expand the already very productive and influential collaboration we have established over the years", he says.

Menno made it no secret that the main reason why he chose NTNU was his desire to return to full-time research.

"It is a pleasure to be able to spend much more time on research. Of course, it is not really full-time, since I do have teaching obligations, but since my teaching activities mainly focus around neuroscience it feels like I am spending almost all of my time on what I like best, neuroscience", he says.

His research goals are also in line with the work being done by the CBM's Moser group.

"The aim of my group is to understand the relationships between how neuronal networks are wired up, and their function. The structures we are interested in are all involved in learning and memory processes, as far as we know. We also have strong indications that their individual contributions to learning and memory are different, yet most likely complementary, and we know that the wiring of their individual networks is very different. So, based on information about how brain structures are wired, can I formulate hypotheses on function? Those hypotheses then should be tested, for example using the Mosers' approaches. Of course, the process works the other way around as well. If they have an idea about a specific function, can we look for anything particular in the network that may be related to or explain that function?", he wonders.

Witter's approach to understanding the brain is building the bridge between the basic research that the Moser group performs, and the clinically oriented research of other parts of the medical faculty.

"If one has a specific idea/hypothesis about what parts of the hippocampal and parahippocampal areas are doing, one promising new way to test those hypotheses, aside from searching for patients that have lesions specific to that area, is to use brain imaging approaches such as magnetic resonance imaging. This is now used to test functional hypotheses related to differences between hippocampus and parahippocampus, with the eventual goal to differentiate between different subareas of the hippocampus and parahippocampus. I have established a collaborative effort with the MI centre at NTNU, where the focus is to develop technology and paradigms to find differentiation within the hippocampus. I also supervise a PhD student in Amsterdam who is focusing on differentiations within the parahippocampal domain. He will join the NTNU MI center as a postdoctoral student later this year. To me this is just another logical extension from structure to function. Moreover, my skills as a neuroanatomist can be quite instrumental to imaging, since I can be of assistance in interpreting where brain activation is found related to certain behaviors", he says.

Witter's neuroanatomy laboratory is state-of-the-art, and is almost up and running. The lab will be fully functional with both people and equipment in place in 2008; two technicians joined Menno a year ago, and the time is now right to fill the lab with more colleagues.

"Most likely 3 – 4 new colleagues will join us in 2008. We currently have two technicians who started to work with me in the first quarter of 2007, after taking their initial training for about 4 months in Amsterdam. We have also attracted the interest of quite a few students both from the medical faculty (students with a research focus) as well as students with different backgrounds through the master's program, which indicates that neuroanatomical research may very well be attractive to young researchers, providing them with good career opportunities because of my group being part of the centre", he observes.

The technicians have a background in biophysics, and Menno emphasizes the importance of, and need for, different scientific backgrounds in his lab. "These different backgrounds actually provide the ability to operate instruments that will allow

Menno Witter

Menno Witter is a professor of neuroanatomy at Centre for the Biology of Memory / Kavli Institute for Systems Neuroscience.

Menno Witter holds a part-time position at the VU University Medical Center Amsterdam to conduct postdoctoral teaching and research on the effect on the developing brain of hormone treatment in young children, with a focus on overall cognitive abilities, specifically learning.

He also has a visiting professorship at the Graduate School for Life Sciences, Tohoku University in Sendai, Japan, where he works on optical imaging of parahippocampal-hippocampal networks and the development of new tracing tools (genetically modified viruses) for anatomical experiments, in addition to teaching.

He has a lectureship at the University of Murcia, Spain in the PhD training programme, with a specific emphasis on Alzheimer's disease.

Additionally, Witter has established a number of other formal international collaborations, and has worked as a consultant on projects on parahippocampal-hippocampal functions and electrophysiology with a number of research groups in the USA.

Discussing confocal data in the new microscope lab (Photo: Mentz Indergaard/NTNU-Info)

us to get started combining more biological approaches with the rather complicated equipment that we are using, such as confocal laser scanning microscopy, electron microscopy, in vitro electrophysiology, and, in 2008, voltage sensitive dye imaging. They have helped enormously in setting up the new lab, from all the ordering that is involved, all the way from paper and gloves, through chemicals up to equipment such as scales and freezers" he says.

Students have already started working in his lab, and Menno is currently tutoring one 'research student' and a post-doc. His group will grow during 2008, and by next Christmas it will have reached what he thinks is the right size.

"In August 2007 we were joined by a research student, and in October my first post-doc arrived, who has a background in invertebrate neuroanatomy and physiology. I had a PhD student in Amsterdam, paid for by CBM, who graduated from the master's programme in neuroscience in Amsterdam. She visits Trondheim to work at the centre now and then. We have accepted a PhD student who will start in March, who has background training through the master's programme in neuroscience at NTNU. In April we will employ a second post-doc who has a PhD in neuroscience and metabolism, and in the course of the year I hope to employ two more post-docs; one with experience in optical imaging and in vitro electrophysiology, and one with a background in neuroanatomy. With all the people in place and some more master's students who have expressed an interest in joining, I feel that the group is reaching the approximate size I had in mind. It also has sufficient variation with respect to background to facilitate scientific discussions", he adds.

A confirmation of excellence

Stefan Leutgeb received 1.75 million Euro (NOK 14 million)from The European Research Council's "Starting Independent Researcher Grants" for his research project 'Memory storage in distributed cell assemblies and its dysfunction in Alzheimer's disease'."The ERC award is a consequence of the outstanding research environment that I have been able to work in during the past five years", says Leutgeb.

"The ERC award is a consequence of the outstanding research environment that I have been able to work in during the past five years"

Only about 3% of the proposals were funded, making Leutgeb's award an immense honour, and a confirmation of excellence. "The university, the centre, and its directors have substantially contributed to enabling an ERC grant to be awarded to a researcher from NTNU and the Kavli Institute", says Stefan Leutgeb. He is a member of the CBM faculty and leader of the Memory Consolidation and Alzheimer's Disease group.

Stefan Leutgeb has received outstanding offers from other universities, as a result of his work at the centre, and will relocate during 2008. Director Edvard Moser is proud of Stefan's achievements and understands Leutgeb's desire to build a research group of his own. Leutgeb himself explains the next step like this:

Training for success

"Being in such an extremely successful research situation makes it difficult to build a research programme that is seen as independent while remaining at the same place where one has been trained. When evaluating the success of the Kavli Institute in the long-term, the institute will also be measured by having successfully trained and placed young researchers at other world-leading institutions and by having built a scientific network that will influence neuroscience research for many decades. It is in the best interest of the Kavli Institute as well as for my research career in the long-term to continue with my own well-respected research programme", says Leutgeb.

Stefan Leutgeb receives flowers from Rector Torbjørn Digernes. (Photo: Klaus Jenssen)

Stefan Leutgeb's research focuses on building the bridge between basic and applied research. "With my research moving towards clinical interests, and with my interest in building collaborations with clinical research and retain those witin the Kavli Institute, there will be a closer link to clinical questions, in particular as the Kavli Institute becomes more prominent in international research efforts.

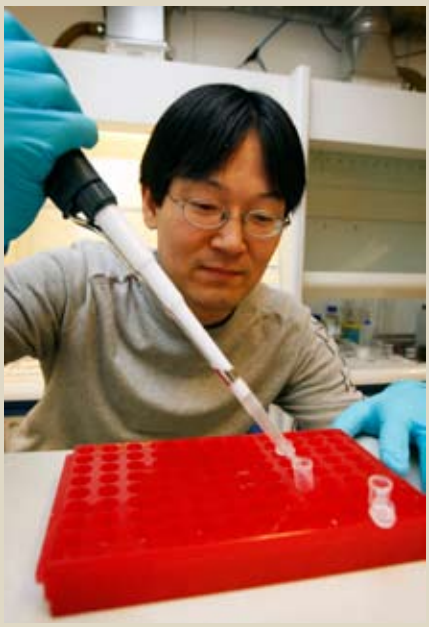
EU millions to the CBM

The European Research Council's "Starting Independent Researcher Grants" is a new financing mechanism established as a part of the basic research programme called "Ideas", which is funded through the EU's 7th Framework Programme. The effort is directed towards up-and-coming young researchers who are establishing their careers in Europe, and is a kind of European "big brother" to the "Young Investigator Awards" (YFF) from the Research Council of Norway. ERC's individual "Starting Grants" are capped at a maximum of 400,000 Euros yearly over four years; for all grants combined, the programme's total budget is NOK 15 million. Leutgeb's application was awarded close to the maximum possible amount.

International recognition

Leutgeb's application was among 559 that were selected for further evaluation out of an original application pool of more than 9000. Ninety-two of those 9000 applications were from Norwegian host institutions. The high number of applicants illustrates that the competition was extremely difficult, which also means that there is a great deal of international recognition associated with winning an award from the ERC.

Ayumu Tashiro was also recognized, with his application making the final round for possible funding in 2008. If Tashiro is awarded a grant, he will establish a virus lab in which he will combine multi-unit recording and behavioural analysis with virus mediated, cell-type-specific genetic manipulation of neuronal activity.



Anticipates substantial progress

Leutgeb believes that there will be substantial progress in the treating various symptoms of the diseases like Alzheimer's, but that it is difficult to predict whether the treatment options will be able to entirely halt the disease progression, as one would expect from a cure.

"Alzheimer's disease is characterized by many cellular and biochemical processes that lead to the loss of connections between cells, and during later stages, to widespread cell death. Although these processes are eventually seen in many cortical regions, they are limited to select regions during the early phases. My research is meant to identify whether the limited onset in the entorhino-hippocampal system has early consequences on the functioning of cells that are connected to these areas", he says.

Basic research and clinical interest

"If a link is found, one would be able to test whether local dysfunction in this system might generate abnormal activity patterns that could be used for diagnosing the disease or even for selectively interfering with the disease while it is still contained to a small subregion of the cortex. Our basic research may not give us a cure for Alzheimer's, but it will give us important knowledge on our way to finding one in the future" he adds.

"In general, I already think that basic research on memory serves a clinical interest, since progress in treating diseases with memory problems will increasingly depend on understanding the biology of the system. The award of the Nobel Prize this year to scientists who invented the transgenic technology to generate disease models in rodents, recognized the major contribution that rodent systems have made to finding treatment for all diseases, not only those of the brain", Leutgeb concludes.

Tashiro studies memory formation in the dentate gyrus, a subregion of the hippocampus. His aim is to determine which memory processes require new neurons, dynamic patterns of activity that new neurons express during memory-related behaviour, and the influence of new neurons on their downstream structure. Information about the functioning of new neurons in the normal brain could contribute to the future development of efficient therapeutic strategies for a variety of brain disorders.

Left: Ayumu Tashiro may receive funding for a new viruslab in 2008
(Photo: Gorm Kallestad/Scanpix)

Jonathan Whitlock receiving Outstanding Alumni Award (Photo: Jonathan Whitlock)

Outstanding Young Alumni

The CBM postdoctoral fellow Jonathan Whitlock received the Outstanding Young Alumni Award from his college institution in the USA. The award is given within 15 years of graduation to individuals who have shown "outstanding accomplishments and promise". Whitlock was selected on the basis of his graduate work at Brown University and MIT, which was published in the journal Science in 2006. The work was later listed by the editors of Science as one of the top 10 breakthrough discoveries of 2006.

Honours and prizes to young CBM and KI researchers

Several young CBM researchers were awarded prestigeous prizes in 2007.

BNA Award

Rosamund Langston accepted the British Neuroscience Association Postgraduate Prize for her PhD dissertation on the role of the hippocampus in event memory in the rat. Langston examined the role that the hippocampus plays in episodic memory in rats. She studied rats while they executed various learning tasks, and combined her study with temporary and permanent pharmacological inactivation of the hippocampus.

CBM researcher Rosamund Langston was awarded the British Neuroscience Association Postgraduate Prize in 2007. (Photo: Emma Wood).

The prize-winner showed how the storage of memory in the brain's cerebral cortex decides what is known from before; she also used tests that mimicked aspects of human episodic memory. These types of results are important in the further study of the neural basis for episodic memory and in establishing a link between animal experiments and clinical experiments.

The Eppendorf Prize

Marianne Hafting Fyhn, PhD was one of two finalists for the Eppendorf & Science

CBM finalist Marianne Fyhn (right) and the first prize winner Rachel Wilson from Harvard Medical School in the United States, at the award ceremony of the Eppendorf Prize in San Diego. (Photo: Eppendorf)

Prize for Neurobiology, which was awarded in San Diego in the USA on November 5, 2007. The first prize was awarded to Rachel Wilson from Harvard Medical School, but Fyhn received very complimentary comments on her essay "The Grid Map in the Brain".

Fyhn started her graduate work in neurobiology at CBM in 2000. She performed in vivo recordings of spatially modulated neurons from the hippocampus and entorhinal cortex of freely behaving rats and contributed to the discovery of grid cells, which are neurons in entorhinal cortex with a remarkable hexagonal activity pattern. Since receiving her PhD in 2005, she has been a postdoctoral fellow at the CBM.

The Eppendorf & Science Prize for Neurobiology acknowledges the increasing importance of this research in advancing our understanding of how the brain and nervous system function – a quest that seems destined for dramatic expansion in the coming decades, said the jury. Eppendorf is an international biotech company that develops, produces and distributes systems for use in life-science research laboratories worldwide.

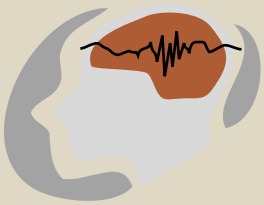
Fridtjof Nansen Prize

The 2007 Fridtjof Nansen Prize for young researchers went to CBM researchers Marianne Fyhn, PhD and Torkel Hafting Fyhn, PhD, for their studies of the neurophysiological basis for the brain's sense of location. The Fridtjof Nansen Prize is awarded to researchers who are not yet 35 years old and who are either Norwegian or researchers with permanent residency in Norway. The 2007 prize was handed out during the Norwegian Academy of Science and Letters' annual meeting on May 3, 2007. The chairman of the board of the Nansen Fund and associated funds, Professor Arnoldus Schytte Blix, handed out the awards.

For more than 100 years, the Nansen Fund and associated funds have played a significant role in the development of Norwegian science. The Nansen Fund's statutes require that the Fund's earnings be used to advance scientific research, and to support the publication of scientific writings, the establishment of prize requirements, the recognition of outstanding scientific discoveries or dissertations, and support for exceptional scientists in unfettered scientific pursuits.

Fridtjof Nansen's Prize for young researchers went in 2007 to CBM researchers Marianne Fyhn, PhD and Torkel Hafting Fyhn, PhD. The prizes were handed out by Professor Arnoldus Schytte Blix. (Photo: Scanpix)

Annual accounts



Income

Transferred from 2006	-921 531
Grants	
Norwegian Centre for Excellence *(SFF)*	11 100 000
Other External projects	9 836 400
Contribution from the Norwegian University of Science and Technology	
S/O funding	1 527 000
Operational grants	1 666 666
Overhead	3 796 684
Total Income	27 005 219

Expenses

Net personnel costs (including social benefits)	13 709 321	
Overhead	3 796 684	
Scientific equipment	1 869 109	
Laboratory consumables	1 952 680	
Other expenses	4 220 033	
Total expenses	25 547 827	
Transferred to 2008 for new equipment in expanded lab areas	1 457 392	

Who's Who

The Board

Arnstein Finset,
Professor
University of Oslo
(chairman) (retired)

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Associate Professor
ProRector,
NTNU

Stig Slørdahl,
Professor
Dean, Faculty of Medicine,
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Associate Professor
Dean, Faculty of Social Science
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May-Britt Moser,
Professor and co-director

Menno P. Witter,
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Visiting professors

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Professor
University of Arizona,
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Bruce McNaughton,
Professor
University of Arizona,
USA

Randolf Menzel,
Professor
Free University of Berlin,
Germany

Richard G. M. Morris,
Professor
University of Edinburgh, UK

Ole Paulsen,
Professor
Oxford University,
UK

Alessandro Treves,
Professor
International School for
Advanced Studies, Italy

Research scientists

Stefan Leutgeb,
Group leader

Jill Leutgeb,
Research Scientist

Ayumu Tashiro,
Research Scientist

Vegard Heimly Brun,
Post doc

Marianne Fyhn,
Post-doc

Torkel Hafting Fyhn,
Post-doc

Laura Colgin,
Post-doc

Karel Jezek,
Post-doc

Dori Derdikman,
Post-doc

James Ainge,
Post-doc

Jonathan Whitlock,
Post-doc

Natalia Kononenko,
Post-doc

Rosamund Langston,
Post-doc

Graduate students


Cathrin Barbara Canto,
Ph.D. student


Kirsten Brun Kjelstrup,
Ph.D student


Paulo Girão,
Ph.D. student


Trygve Solstad,
Ph.D. student


Espen Joakim Henriksen,
Ph.D. student


Charlotte Boccara,
Ph.D. student

Project students


Tora Bonnevie,
Project student


Adam Johnson,
Project student (retired)


Jørgen Sugar,
Project student


Magdalene Schlesiger,
Project student

Master students


Charlotte Boermeester Alme,
Master


Henriette Folkvard Hestvaag,
Master


Veslemøy Mæhle Hult,
Master

Technical team


Ingvild Hammer,
Bioengineer


Kyrre Haugen,
Histology technician


Klaus Jenssen,
Electronics engineer


Raymond Skjerpeng,
Programmer


Haagen Waade,
Computer engineer


Ingunn E. Bakken,
Senior executive officer (retired)


Ann Mari Amundsgård,
Histology and animal care


Espen Sjulstad,
Histology and electrode wiring


Knut S. Grøn,
Animal technician (part-time) (retired)


Ellen Marie Husby,
Technician


Hege J. Tunstad,
Pr Info


Ragnhild Gisetstad,
Technician


Gudrun Kulbotten Sjøvold,
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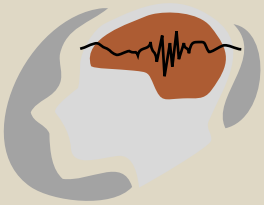
Gerit Pfuhl,
Ph.D. student


Hanna Mustaparta,
Professor NTNU, Norway


Hanne Lehn,
Ph.D. student


Robert Biegler,
Associate professor NTNU (Psychology), Norway

Publications



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Photo, frontpage: Floris G. Wouterlood and Amber Boekel

Annual Report for KI-CBM 2007

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