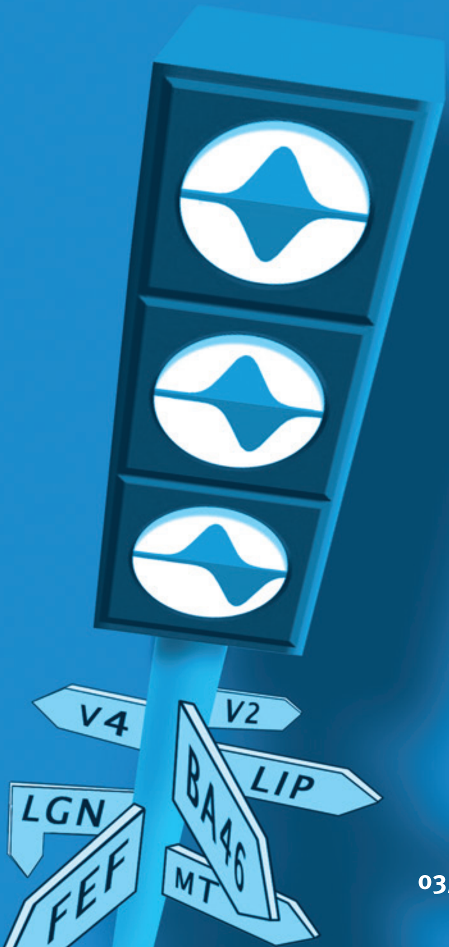
Bernstein Network for Computational Neuroscience

Bernstein Newsletter



Recent Publications
Traffic lights in the brain – Knows no pain – Fast rhythms give the brain a nudge – Learning efficiently by concentrating on the essential

News and Events
Declaration of Basel – Personalia – New IMPRS in Frankfurt – First G-USA collaborations – Two new CRCs in Berlin, Göttingen

03/2011

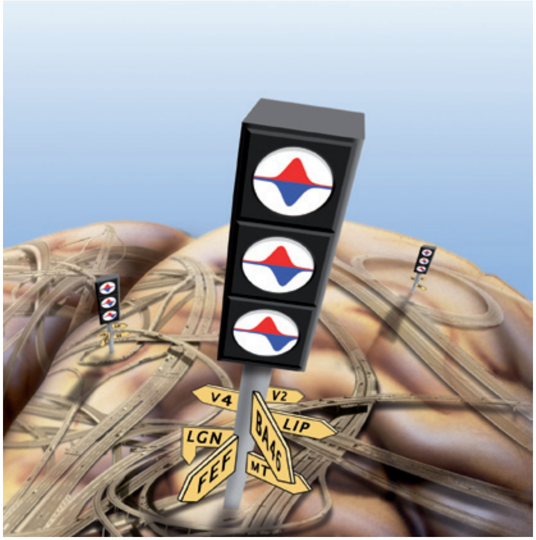
Traffic lights in the brain

In every waking minute, we have to make decisions – sometimes within a split second. Neuroscientists at the Bernstein Center and the University of Freiburg have now discovered a possible explanation for how the brain chooses between alternative options. The key lies in extremely fast changes in the communication between single nerve cells.

The traffic light changes from green to orange – should I push down the accelerator a little bit further or rather hit the brakes? Our daily lives present a long series of decisions we have to make, and sometimes we only have a split second at our disposal. Often the problem of decision-making entails the selection of one set of brain processes over multiple others seeking access to the same resources. Several mechanisms have been suggested how the brain might solve this problem. However, up to now, it is a mystery what exactly happens during a rapid choice between two options. Jens Kremkow, Arvind Kumar, and Ad Aertsen now propose a mechanism how the brain can choose between possible actions – already at the level of single nerve cells.

As the structure and activity of the brain are just too complex to answer this question through a simple biological experiment, the scientists constructed a network of neurons in the computer. An important aspect of the model in this context is the property of nerve cells to influence the activity of other nerve cells, either in an excitatory or inhibitory manner. In the constructed network, two groups of neurons acted as the senders of two different signals. Further downstream in the network, another group of neurons, the "gate" neurons, were to control which of the signals would be transmitted onward.

As the cells within the network were connected both with exciting and inhibiting neurons, the signals reached the gate



The timing of exciting (red curves) and inhibiting (blue curves) signals could be a way to control the "traffic flow" of activity in the brain.

as excitatory and, after a short delay, inhibitory activity. In their simulations, the scientists found that the key for the gate neurons' "decision" in favour of one signal over the other was the time delay of the inhibitory signal relative to the excitatory signal. If the delay was set to be very small, the activity of the cells in the gate was quenched too quickly for the signal to be propagated. Conversely, a larger delay caused the gate to open for the signal. Results from neurophysiological experiments have already shown that a change in delay properties is possible in real neurons. These findings therefore support the hypothesis of Kremkow and colleagues that such temporal gating can form the basis for selecting one of several alternative options in our brain.

Text: Gunnar Grah, Bernstein Center Freiburg

Kremkow J., Aertsen A. & Kumar A. (2010): J. Neurosci. 30(47): 15760-15768.

Knows no pain

It is the pain that sometimes makes diseases unbearable. In particular, various kinds of chronic pain can still not be treated satisfactorily. The need for novel efficient medicaments is high, and for their development a better understanding of the basis of pain perception is essential.

An international research team including Josef Penninger (IMBA, Vienna), Clifford Woolf (Harvard Medical School, Boston), Andreas Hess and Kay Brune (Friedrich Alexander University Erlangen-Nuremberg and Bernstein Collaboration Physiology and Imaging) has now identified a gene that is involved in the pain perception of such diverse organisms as fruit flies, mice and humans. If it is missing or altered, the affected individuals feel no or significantly less pain.

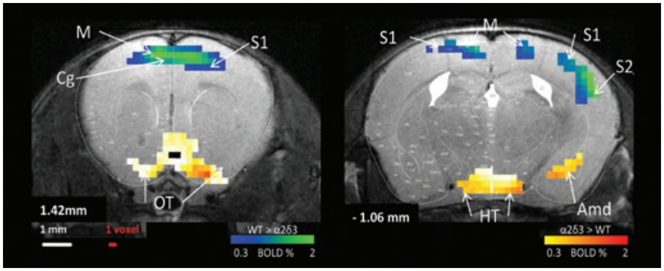
How can one search for a gene that is linked to a subjective sensation like pain? In this particular study a simple behavioral test was the key. The researchers locked up groups of fruit flies in a chamber the walls of which had a pleasant temperature of about 30 degrees celsius, while the floor could be heated to painful 46 degrees. If pain perception was intact, the animals avoided the floor and crawled onto the walls. If pain perception was altered, however, they spread evenly over the floor and walls.

In order to "fish out" the genes that, among the many thousands of fly genes, could be involved in pain perception, the researchers made use of a modern high-throughput method. They used their pain test systematically on many thousands of different fly groups, in each of which one particular gene had been turned off. In this way, they identified approximately 600 candidate genes.

One of the groups particularly attracted the researchers' attention: It was lacking the "straightjacket" gene, belonging to a gene family that also occurs in mammals and humans, and one product of which is the target of existing analgesics. Mouse mutants in which the mouse variant of the gene was knocked out showed no avoidance of hot surfaces. Human patients with variants of the gene had less chronic pain after intervertebral disc surgery.

Modern functional magnetic resonance (MR) imaging techniques provided first hints that, in these mouse mutants, a previously unknown neuronal control mechanism apparently prevented pain transmission in the brain. While the pain signals were registered by the paws and transmitted normally up until the thalamus, they failed to penetrate far enough into the brain to be perceived as painful and to trigger an escape reaction. If it were possible to activate this control mechanisms in humans in order to interrupt pain transmission, this could open up new possibilities for the relief of chronic pain.

Neely et al. (2010): Cell 143: 628-638.



MR images of cuts through the brain of mice (WT = normal mouse; α2δ3 = gene deficient mutant). After a noxious stimulus, mutants show less activation in pain centers as compared to normal mice (indicated by green-blue colour).

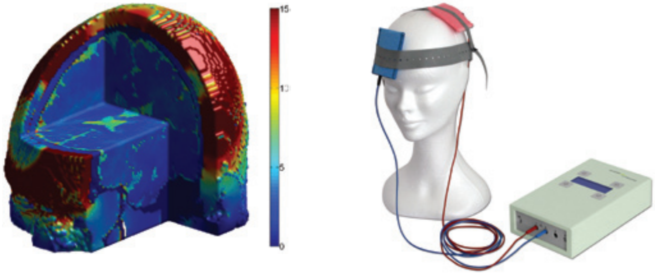
Fast rhythms give the brain a nudge

Many neurological disorders are associated with inappropriate or insufficient activity in certain brain areas. In Parkinson's patients, for example, the brain has difficulties in generating the necessary go-signal to launch a movement. Wouldn't it be nice if one could give a patient's brain a gentle nudge in order to get its activity back on track?

Brain activity mainly consists of tiny electrochemical currents. It is known for centuries that brain activity can be electrically influenced from outside. There are basically two options for this.

In the simplest, classical variant, two electrodes are placed on the scalp, and current pulses are sent through the skull (transcranially) and the brain. If the current flows through the eye, the subject perceives a flash of light. Strong short electric pulses are used in electroconvulsive therapy for ameliorating depression. The disadvantage of this method is, however, that it indiscriminately stimulates all brain areas between the electrodes. Correspondingly, the effects are rather nonspecific.

For about two decades, an alternative method is being used that specifically addresses closely circumscribed small brain areas: transcranial magnetic stimulation (TMS). Here, electric currents flowing in a magnetic coil placed on the head induce corresponding small currents in the brain. Depending on location and type of stimulation, different effects can be evoked: Single magnetic pulses to the motor cortex cause a brief twitching of individual muscles. Short series of 1-20 pulses per second applied to higher brain areas induce subtle changes in very specific behavioral capacities, which, however, cease quickly after ending the stimulation.



Left: Device for transcranial direct and alternating current stimulation, developed in a Bernstein Collaboration with the company neuroConn. Right: Calculated current density distribution in false colors with transcranial AC stimulation of 140 Hz and 1mA over the left sensorimotor cortex. Warm colors indicate brain areas with strong current flow. Image: A. Waldo, G. Knoll, Kassel University, and H. Buchner, Knappschaftskrankenhaus Recklinghausen.

Scientists around Walter Paulus at the University Medicine, the Bernstein Center and Bernstein Focus Neurotechnology Göttingen and the Bernstein Collaboration "Transcranial Stimulation" have now for the first time explored a third approach. They stimulated the brain with alternating currents that changed their polarity in a fast rhythm. Electrical activity waves in the applied frequency range also occur naturally in the brain, e.g. in the hippocampus and during states in which the brain is particularly sensitive to environmental stimuli. The scientists found that a 10-minute electrical alternating current increased brain excitability. This effect outlasted the stimulation for more than an hour. Stimulation with a frequency of 140 Hz was most effective. As a measure of excitability, the scientists used the strength of motor signals that were triggered by the well-established TMS technique. Further experiments will have to show whether the approach of giving the brain a nudge by high frequency AC stimulation can also be applied in patients to stimulate their brain activity, opening up new alleys for medical treatment.

Moliadze V., Antal A., Paulus W. (2010): J. Physiol. 588: 4891-4904.

Learning efficiently by concentrating on the essential

The ability to identify individual objects among the masses of sensory impressions that keep bombarding us is not something we are born with. What adults achieve without effort – for example, in a blink of an eye spotting the car key on your desk, even though it is half covered by a book – is a truly magnificent accomplishment that is beyond new-born humans and even high-tech cameras with the most sophisticated software.

Even in the small world of a child‘s room, there are thousands of different objects that keep changing their appearance when viewed from different angles or under different lighting conditions. How does the brain learn to merge these different impressions into the percept of a single object, given that it does not have a teacher who would provide detailed instructions on how to do so?

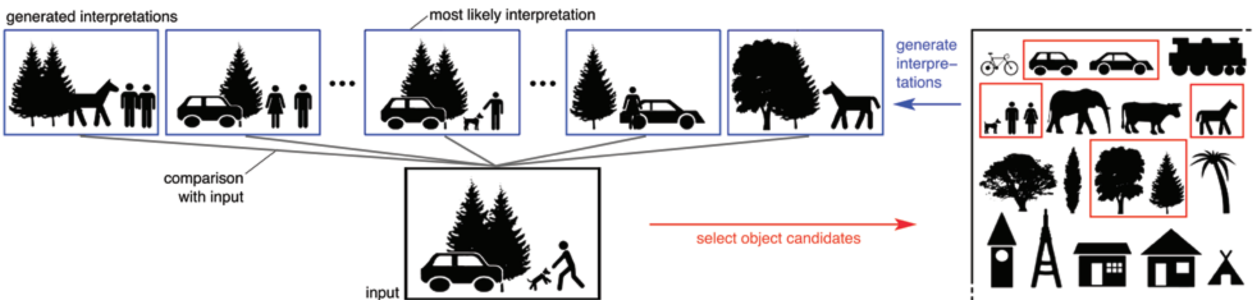
One hypothesis is that, while collecting sensory impressions, the brain uses their statistics to modify its own structures such that they mimic the features of the impinging stimuli. Theoretical models that operate on the basis of this principle are called “generative models”. If they are fed with data, they change their own settings in each calculation step such that these become more and more similar to the data. Such models are called “generative” because they can be used to generate data – so to speak “realistic” fantasy data.

The only problem is that it takes these models ages to learn as soon as the sensory data are a little more complex. Jörg Lücke from the Bernstein Focus Neurotechnology and the Goethe University in Frankfurt, together with Julian Eggert from Honda Research Institute Europe, have now found a trick that substantially accelerates the learning process of generative models. They fed their model with noisy images of objects, and instructed it to focus its learning on combinations of especially promising object candidates (s. fig.). These candidates were selected by a fast preprocessing stage, similar to what the brain probably uses. Furthermore, the system learned to ignore too complex combinations of objects. In this way, it was able to learn image elements from noisy data within a few hours, with an accuracy that normally would have taken years to be achieved. The learned components could then be used to identify complex input patterns as combinations of their parts. This allowed, for instance, to correctly reconstruct noise-free letters from noisy handwriting.

One can easily imagine all kinds of future applications of such self-learning technical wizards, reaching from automatic object recognition over noise reduction up to data compression. And all this with amazing speed and without any teacher!

Lücke J. & Eggert J. (2010): J. Machine Learning Res. 11: 2855-2900.

Inference process for a generative model of visual scenes.



Declaration of Basel about a responsible approach to animal research

Neuroscientific research is interdisciplinary and, to be successful, it requires a combination of a variety of methodological approaches. Experiments involving animals are an indispensable part of these approaches. While Computational Neuroscience can predict and test certain functions of the brain with the help of theoretical models and computer simulations, the underlying data must initially be collected in real organisms, and theoretical computations must continuously be checked in living systems. Reliable conclusions about the function of the brain can only be derived from the interplay of theory and experiment.

Naturally, animal experiments require a special sense of responsibility and careful consideration of animal welfare legislation. The latter are, and justifiably so, subject to intense discussions in the national and international public and politics. In September 2010, this discussion has led to the new EU directive on the use of animals in research. The new directive, however, contains regulations that in some areas considerably hamper research, without improving animal welfare. And despite the stricter rules, researchers at times find themselves targets of irrational, sometimes even criminal, personal attacks.

To take the discourse on animal experiments to a rational level, scientists, the public and politics must inform themselves more actively about the importance of research and a responsible approach to animal experiments. To this end, around 80 scientists from Switzerland, Germany, Sweden, France and Great Britain convened in Basel for the two-day conference "Research at a Crossroads", co-directed by Stefan Treue (Director of the German Primate Center in Göttingen, member of the Bernstein Center and Bernstein Focus Neurotechnology Göttingen).

The conference resulted in the "Declaration of Basel", signed on November 29, 2010, that calls for more trust, transparency and communication in animal research. In the declaration, the delegates commit themselves to a responsible approach to the handling of animals in animal research, and declare that they will in all experiments acknowledge and adhere to the 3R principles ('Refine, Reduce, Replace' animal experiments). At the same time, the signatories of the declaration emphasized that research involving animals is an indispensable pillar of biomedical research and must remain allowed now and in the future. They called upon the scientific community around the world to sign the Declaration of Basel and to act accordingly. The declaration can be signed on the website of the Declaration of Basel: www.basel-declaration.org.

See also two articles in Nature on this issue:
www.nature.com/nature/journal/v468/n7325/full/468731b.html, www.nature.com/news/2010/101208/full/468742a.html.

Stefan Treue (Bernstein Center and Bernstein Focus Neurotechnology Göttingen, Director of the German Primate Center, right), Dieter Imboden (President of the Research Council of the Swiss National Science Foundation, middle) and Michael Hengartner (Dean of the Faculty of Science at the University of Zurich, left) sign the Declaration of Basel.

Personalia

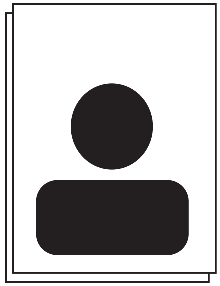
Ad Aertsen (BCF, Albert Ludwigs University Freiburg) was elected new member to the German Academy of Sciences Leopoldina. Source: www.bcf.uni-freiburg.de/news/generic-news/20101210-leopoldina/

Ernst Bamberg (BFNT Göttingen, Director at the MPI of Biophysics, Frankfurt), together with other scientists, was awarded the Karl Heinz Beckurts Award for the discovery of light-activated ion channels and their application in neurobiology. Source: www.idw-online.de/de/news401069 (in German)

Jan Born (BFNL State dependencies of learning, Lübeck University) accepted the W3 professorship "Medical Psychology and Neuroendocrinology" at the Eberhard Karls University Tübingen. The Helmholtz Association finances the first three years of the professorship, after which Born succeeds Niels Birbaumer (BFNT Freiburg-Tübingen). www.nncn.de/nachrichten-en/born

Jochen Braun (BGCN and Otto von Guericke University Magdeburg) heads the new EU project CORONET, supported by the European Commission with 2.7 Mio. €. It aims at developing novel interfaces between brain and computer and builds upon previous research of the Bernstein Group Magdeburg.
www.nncn.de/nachrichten-en/coronet/

Simone Cardoso de Oliveira (BCOS), **Julia Fischer** (BCCN and German Primate Center Göttingen) and **Shu-Chen Li** (BFNL Complex human learning, MPI for Human Development, Berlin) are listed on the internet portal AcademiaNet. The platform is meant to facilitate finding excellent female scientists as members to committees and to increase the proportion of women in scientific leadership positions. www.academia-net.de (in German)



Onur Güntürkün (BFNL Sequence learning, Ruhr University Bochum) is coordinator of the new DFG Research Unit 1581 "Extinction Learning: Behavioural, Neural and Clinical". Source: www.aktuell.ruhr-uni-bochum.de/pm2010/pm00416.html (in German)

Benjamin Lindner (MPI for the Physics of Complex Systems, Dresden) accepted the W2 professorship "Theory of Complex Systems and Neurophysics" at the BCCN and the Humboldt University Berlin. Source: www.idw-online.de/de/news403876 (in German)

Poramate Manoonpong (Postdoc at BCCN Göttingen) heads the Emmy Noether Research Group "Neural Control, Memory, and Learning for Complex Behaviors in Multi Sensori-Motor Robotic Systems", starting in March 2011 at the Georg August University Göttingen. www.nncn.de/nachrichten-en/emmynoether-manoonpong

Hans Georg Näder, Managing Director of the Otto Bock Group, received the honorary membership of the Georg August University Göttingen for repeatedly generously supporting of the University. The Otto Bock Healthcare GmbH is industry partner of BCCN and BFNT Göttingen. Source: www.uni-goettingen.de/de/3240.html?cid=3731 (in German)

Jens Timmer (BCF, Albert Ludwigs University Freiburg) receives a Hector Fellowship by the Hector Foundation II. The award honors researchers of an excellence university who are distinguished by their high quality research, their engagement in teaching and by contributions to the advancement of their university. www.nncn.de/nachrichten-en/hectorfellowship

Christian Büchel receives two prestigious awards

Christian Büchel, head of the Department of Systems Neuroscience at the University Hospital Hamburg-Eppendorf (UKE) and coordinator of the Bernstein Focus Neuronal Basis of Learning: Complex Human Learning, was awarded the Gottfried Wilhelm Leibniz Prize 2011. With up to 2.5 Mio. €, the prize is the most remunerative German research award. Büchel received the prize for his fundamental research results on neuronal network features that contribute to complex brain processes such as learning, memory, speech, fear, and pain.
Source: www.idw-online.de/de/news400057 (in German)

Additionally, Christian Büchel's research is supported with an "Advanced Investigator Grant" by the European Research Council (ERC). Büchel's ERC project "The placebo effect – a window into the relationship between mind and body" was selected as one of 266 successful projects from approximately 2009 proposals within physical sciences and engineering, life sciences and social sciences and humanities. ERC Advanced Investigator Grants allow exceptional established research leaders to pursue ambitious, pioneering and unconventional research. Projects are supported with up to 3.5 Mio. € for a duration of up to five years.
Source: www.idw-online.de/pages/de/news405620 (in German)

New IMPRS for Neural Circuits in Frankurt

The Max Planck Society recently established the International Max Planck Research School (IMPRS) for Neural Circuits in Frankfurt. Besides the Max Planck Institutes for Brain Research and for Biophysics, the Goethe University and the University Hospital, the Frankfurt Institute for Advanced Studies (FIAS) and the Ernst Strüngmann Institute participate in the program.

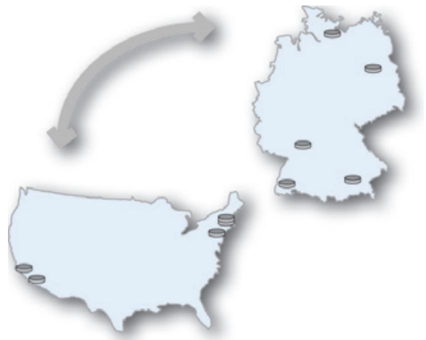
Among the faculty are numerous members of the Bernstein Network: Ernst Bamberg (BFNT Göttingen), Christoph von der Malsburg, Jochen Triesch, Wolf Singer (BFNT Frankfurt), and Gabriel Wittum (BGCN Heidelberg and BFNT Frankfurt).

Common objective of the IMPRS for Neural Circuits is the understanding of simple up to large and complex neural circuits. This requires analyses at multiple levels: from the molecular and cellular level over multi-cellular networks up to the behavioral level.

Within the framework of the IMPRS, ten positions are offered for excellent students with a Master's or Bachelor's degree in a relevant field. The program language is English, deadline for applications is March 15, 2011.
Source:
www.mpih-frankfurt.mpg.de/global/menue/IMPRS/

First G-USA Collaborations in CNS

The German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF), the National Science Foundation (NSF) and the National Institutes of Health (NIH) established in 2009 the joint funding measure "Germany-USA Collaborations in Computational Neuroscience". The funding scheme supports transnational collaborative projects. On the American side, it is part of the "Collaborative Research in Computational Neuroscience" (CRCNS) program, on the German side, it is a component of the Bernstein Network. First calls for applications were published in November 2009 and 2010, further calls are expected.



The following projects are funded in the first round, starting 2010:

- **Hippocampal representation of auditory und spatial sequences**, Christian Leibold (Munich), Stefan Leutgeb (San Diego)
- **Role of astrocytes in cortical information processing** , Klaus Obermayer (Berlin), Mriganka Sur (Cambridge)
- **Effects of weak applied currents on memory consolidation during sleep**, Lisa Marshall, Thomas Martinetz (Lübeck), Lucas C. Parra (New York)
- **Persistent activity in the entorhinal cortex in vivo**, Thomas Hahn (Mannheim), Mayank Mehta (Los Angeles)
- **Integration of bottom-up and top-down signals in visual recognition**, Andreas Schulze-Bonhage (Freiburg), Gabriel Kreiman (Cambridge)

www.nncn.de/nachrichten-en/dusacollaborationnews

New CRCs in Berlin and Göttingen

Two Collaborative Research Centers (CRCs) with participation of Bernstein Centers were approved for January 1, 2011.

The Berlin CRC 910 is entitled "Control of self-organizing non-linear systems: theoretical methods and application of concepts". Coordinator is Eckehard Schöll (BCCN and Technical University Berlin). Besides the Technical University, also the Free University, the Humboldt University, the Fritz Haber Institute, the Federal Institute of Physics and Technology and the Weierstrass Institute for Applied Analysis and Stochastics participate in the center.

Coordinator of the new CRC 889: "Cellular mechanisms of sensory processing" in Göttingen is Tobias Moser (BCCN, BFNT and Georg August University Göttingen). Furthermore, the German Primate Center, the Max Planck Institutes for Biophysical Chemistry, for Dynamics and Self-Organization and for Experimental Medicine as well as the Weizmann Institute of Science, Rehovot, Israel, are involved.

Source:
www.dfg.de/service/presse/pressemitteilungen/2010/
pressemitteilung_nr_65/index.html (in German)

Upcoming Events

Termin / Date	Titel / Title	Organizers / Organisation	URL
Mar. 23-27, Göttingen	9th Göttingen Meeting of the German Neuroscience Society (with Bernstein booth and various contributions by Bernstein members)	S. Korsching, M. Bähr, U. Heinemann, I. Zerr	www.nwg-goettingen.de/2011/
Mar. 25 - Apr. 1, Günne at Lake Möhne	Interdisziplinary College: Autonomy, Decisions and Free Will	J.-D. Haynes (BCCN Berlin), M. Pauen, I. Wachsmuth	www.ik2011.de
Mar. 30 - Apr. 2, Delmenhorst	Excellence Workshop: Computational Aspects of Learning	K. Pawelzik (BGCN Bremen, BFNL Sequence Learning), U. Ernst (BPCN, BGCN Bremen)	www.h-w-k.de/index.php?id=1734
May 1- 7, CapoCaccia, Sardinia, Italy	IM-CLeVeR Spring School (with J. Triesch, BFNT Frankfurt, as speaker)	J. Law	www.im-clever.eu/announcements/events/first-im-clever-summer-school-1
May 16-18, Seoul, Korea	IEEE International Workshop on Pattern Recognition in NeuroImaging	S.-W. Lee, C. Davatzikos, D. Van De Ville, B. Blankertz (BCCN & BFNT Berlin, in program committee)	http://brain.korea.ac.kr/prni2011/index.php
June 13-15, Espoo, Finland	8th Workshop on Self-Organizing Maps	T. Kohonen, T. Honkela, K. Obermayer (BCCN & BFNT Berlin, in program committee)	www.cis.hut.fi/wsom2011/
June 14-17, Espoo, Finland	International Conference on Artificial Neural Networks (ICANN), 2011	E. Oja (K.-R. Müller, K. Obermayer, BCCN & BFNT Berlin, area chairs)	www.cis.hut.fi/icann2011/
June 19-24, Bertinoro, Italy	FENS-IBRO SfN School: Causal Neuroscience: Interacting with neural circuits (with M. Brecht, BCCN Berlin, H. Monyer, BCCN Heidelberg - Mannheime & BGCN Heidelberg as faculty)	G. Buzsaki, M. Häusser	http://fens.mdc-berlin.de/fens-ibro-schools/2010/schools/read.php?id=2057
July 6-8, London, UK	IMPRS NeuroCom Summer School (with M. Ernst, BCCN Tübingen, A. Villringer, BCCN Berlin)	MPI for Human Cognitive & Brain Sciences (Leipzig), Institute of Cognitive Neuroscience, UCL (London)	http://imprs-neurocom.mpg.de/summerschool/index.html
July 23-28, Stockholm, Sweden	20th Annual Computational Neuroscience Meeting (CNS)	Organization for Computational Neuroscience, K. Obermayer (BCCN Berlin, in executive committee)	www.cnsorg.org/index.shtml

Upcoming Events (ctd.)

Termin / Date	Titel / Title	Organizers / Organisation	URL
Aug. 1-26, Bedlewo, Poland	16th Advanced Course on Computational Neuroscience (with Bernstein members as faculty)	D. Jäger, P. Latham, Y. Prut, C. van Vreeswijk, D. Wojcik, T. Bem	www.neuroinf.pl/accn
Aug. 24-27, Frankfurt a. M.	IEEE-ICDL-EPIROB Conference	A. Cangelosi, J. Triesch (BFNT Frankfurt)	www.icdl-epirob.org
Sept. 4-6, Boston, USA	INCF Congress of Neuroinformatics, 2011	International Neuroinformatics Coordinating Facility (INCF)	www.neuroinformatics2011.org
Sept. 19-20, Göttingen	Ribbon Synapses Symposium 2011	F. Schmitz, H. von Gersdorff, T. Moser (BCCN and BFNT Göttingen), J.S. Rhee, T. Pangrsic, D. Riedel, E. Reisinger, M. Rutherford, N. Strenzke, C. Wichmann	www.rss2011.uni-goettingen.de
Oct. 4-6, Freiburg	Bernstein Conference 2011	U. Egert, A. Aertsen, F. Dancoisne, G. Grah, G. Jäger, B. Wiebelt (BCCN Freiburg / BFNT Freiburg-Tübingen), S. Cardoso (BCOS)	www.bc11.de
Oct. 16-21, Freiburg	BCF/NWG Course: Analysis and Models in Neurophysiology	S. Rotter, U. Egert, A. Aertsen, J. Kirsch (BCCN Freiburg / BFNT Freiburg-Tübingen), S. Grün (BCCN Berlin)	www.bcf.uni-freiburg.de/events/conferences/20111016-nwgcourse

The Bernstein Network

Bernstein Centers for Computational Neuroscience (BCCN)
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Göttingen – Coordinator: Prof. Dr. Theo Geisel
Heidelberg / Mannheim – Coordinator: Dr. Daniel Durstewitz
Munich – Coordinator: Prof. Dr. Andreas Herz
Tübingen – Coordinator: Prof. Dr. Matthias Bethge

Bernstein Focus: Neurotechnology (BFNT)
Berlin – Coordinator: Prof. Dr. Klaus-Robert Müller
Frankfurt – Coordinators: Prof. Dr. Christoph von der Malsburg, Prof. Dr. Jochen Triesch, Prof. Dr. Rudolf Mester
Freiburg/Tübingen – Coordinator: Prof. Dr. Ulrich Egert
Göttingen – Coordinator: Prof. Dr. Florentin Wörgötter

Bernstein Focus: Neuronal Basis of Learning (BFNL)
Visual Learning – Coordinator: Prof. Dr. Siegrid Löwel
Plasticity of Neural Dynamics – Coordinator: Prof. Dr. Christian Leibold
Memory in Decision Making – Coordinator: Prof. Dr. Dorothea Eisenhardt
Sequence Learning – Coordinator: Prof. Dr. Onur Güntürkün
Ephemeral Memory – Coordinator: Dr. Hiromu Tanimoto
Complex Human Learning – Coordinator: Prof. Dr. Christian Büchel
State Dependencies of Learning – Coordinators: PD Dr. Petra Ritter, Prof. Dr. Richard Kempter
Learning Behavioral Models – Coordinator: Dr. Ioannis Iossifidis

Bernstein Groups for Computational Neuroscience (BGCN)
Bochum – Coordinator: Prof. Dr. Gregor Schöner
Bremen – Coordinator: Prof. Dr. Klaus Pawelzik
Heidelberg – Coordinator: Prof. Dr. Gabriel Wittum
Jena – Coordinator: Prof. Dr. Herbert Witte
Magdeburg – Coordinator: Prof. Dr. Jochen Braun

Bernstein Collaborations for Computational Neuroscience (BCOL)
Berlin-Tübingen, Berlin-Erlangen-Nürnberg-Magdeburg, Berlin-Gießen-Tübingen, Berlin-Constance, Berlin-Aachen, Freiburg-Rostock, Freiburg-Tübingen, Göttingen-Jena-Bochum, Göttingen-Kassel-Ilmenau, Göttingen-Munich, Munich-Heidelberg

Bernstein Award for Computational Neuroscience (BPCN)
Prof. Dr. Matthias Bethge (Tübingen), Dr. Jan Benda (Munich), Dr. Susanne Schreiber (Berlin), Dr. Jan Gläscher (Hamburg), Dr. Udo Ernst (Bremen)

Project Committee
Chairman of the Bernstein Project Committee:
Prof. Dr. Andreas Herz
Deputy Chairman of the Project Committee:
Prof. Dr. Theo Geisel

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