Introductory Remarks to Symposium 1

The cholinergic system and visual attention: From animal to man

Christiane Thiel and Gregor Rainer, Oldenburg and Fribourg (Switzerland)

The cholinergic system plays a role in several cognitive functions including learning or attention, and has been implicated in several neurological disorders such as Alzheimer's disease. The aim of this symposium is to present recent advances in our understanding of how cholinergic neuromodulation impacts on neural correlates of vision and attention. The speakers cover a wide range of techniques and approaches ranging from electrophysiological recording of neural activity to functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG), which enable the investigation of neurochemical modulation. Alex Thiele will address the impact of cholinergic neurotransmission on neural activity in monkey visual cortex, and Gregor Rainer will focus on effects of basal forebrain deep brain stimulation on the primary visual cortex of the tree shrew. Elvire Vaucher will focus on the role of cholinergic stimulation for visual learning in rats. Markus Bauer will talk on cholinergic modulation of visual attention and neural oscillations assessed with MEG. Christiane Thiel will present fMRI data investigating cholinergic effects on visual attention in healthy humans.

Together, the symposium will summarize recent progress and outline important current and future directions pertaining to the role that cholinergic neurotransmission plays in normal and disturbed visual and attentional processes in animal and man.

Symposium 1

Wednesday, March 13, 2013
15:00 – 18:00, Lecture Hall 102

Chair: Christiane Thiel and Gregor Rainer, Oldenburg and Fribourg (Switzerland)

15:00 **Opening Remarks**

15:05 Alexander Thiele, Newcastle upon Tyne, UK
CHOLINERGIC NEUROPHARMACOLOGY OF VISUAL ATTENTION (S1-1)

15:30 Gregor Rainer, Fribourg, Switzerland
BASAL FOREBRAIN STIMULATION REGULATES CONTRAST SENSITIVITY IN PRIMARY VISUAL CORTEX (S1-2)

15:55 Julia Veit, Fribourg, Switzerland
LAMINAR ASPECTS OF CHOLINERGIC EFFECTS ON PRIMARY VISUAL CORTEX (S1-3)

16:10 **Coffee Break**

16:35 Elvire Vaucher, Montreal, Canada
CHOLINERGIC MODULATION OF VISUAL PERCEPTION IN RODENTS (S1-4)

17:00 Markus Bauer, London, UK
CHOLINERGIC ENHANCEMENT OF VISUAL ATTENTION AND NEURAL OSCILLATIONS IN THE HUMAN BRAIN (S1-5)

17:25 Christiane Thiel, Oldenburg
CHOLINERGIC MODULATION OF VISUAL ATTENTION AS ASSESSED WITH PHARMACOLOGICAL FMRI (S1-6)

17:50 **Concluding Remarks**

Introductory Remarks to Symposium 2

Local Synaptic Coding in the Retina

Tom Baden, Timm Schubert and Thomas Euler, Tübingen

Far from being simple logical gates, neurons employ their specific morphologies and membrane properties to compute complex activity patterns locally within their neurites. At the dendrites, integration of synaptic inputs is used for computations such as noise reduction, input filtering or coincidence detection. But before the activity patterns are transmitted to postsynaptic targets, modulation by presynaptic inputs impinging on axonal terminals can fundamentally affect information transfer within neuronal networks. Recently, bipolar cells have become a key model to study presynaptic computation at axon terminals within a highly defined stimulus space.

As a sophisticated image processor, the retina breaks light modulated in space, time and wavelength into more than 20 parallel output channels. This parallel representation of the visual world is primarily established within the retina's two synaptic layers, and bipolar cells are the only neurons that transmit visual information from photoreceptors in the outer plexiform layer to ganglion and amacrine cells the inner plexiform layer. Unlike classical all-or-nothing-type synapses, the large presynaptic terminals of bipolar cells employ ribbon-type synapses which support both slow, graded and fast, transient modes of transmitter release. Although bipolar cells have traditionally been thought of as rather passive elements, which simply integrate and forward information from the outer to the inner retina, recent findings indicate that many key computations performed by the retinal network take place locally within the multiple synaptic terminals of a single bipolar cell. Through bipolar cell terminal-specific inputs from amacrine cells as well as a plethora of mechanisms intrinsic to individual terminals, visual information transmitted onto retinal ganglion cells can now be understood in a new light. In this view, synaptic computations within the retina's inner plexiform layer are fundamental to network function, and acknowledge a highly localized view of visual processing.

This symposium is supported by the Bernstein Center for Computational Neuroscience Tübingen (www.bccn-tuebingen.de).

Symposium 2

Wednesday, March 13, 2013
15:00 – 18:00, Lecture Hall 105

Chair: Tom Baden, Timm Schubert and Thomas Euler, Tübingen

15:00 **Opening Remarks**

15:05 Robin Kemmler, Tübingen
SYNAPTIC INTERACTIONS IN THE OUTER RETINA OF THE MOUSE (S2-1)

15:20 Leon Lagnado, Cambridge, UK
USING FLUORESCENT PROTEINS TO INVESTIGATE SYNAPTIC TRANSMISSION OF VISUAL INFORMATION (S2-2)

15:45 Tom Baden, Tübingen
THE BIPOLAR CELL TERMINAL AS A SELECTIVE SPATIO-TEMPORAL FILTER (S2-3)

16:10 Robert G. Smith, Philadelphia, USA
LOCAL COMPUTATIONS IN DENDRITES AND AXONS OF THE INNER RETINA (S2-4)

16:35 **Coffee Break**

16:55 Espen Hartveit, Bergen, Norway
FEEDBACK MECHANISMS OF ROD BIPOLAR CELLS IN THE HEALTHY AND DISEASED RETINA (S2-5)

17:20 Sonja Neumann, Frankfurt/Main
SYNAPTIC CIRCUITRY OF A SMALL BISTRATIFIED AMACRINE CELL IN PRIMATE RETINA (S2-6)

17:35 William N. Grimes, Seattle, USA
CHANGES IN THE SYNCHRONY OF CROSS-SYNAPTIC OUTPUT OF A RETINAL NEURON (S2-7)

Introductory Remarks to Symposium 3

The Computational role of the hippocampus

Sen Cheng and Laurenz Wiskott, Bochum

Since anterograde amnesia was reported in patient HM over 50 years ago, a huge number of studies have examined the role of the hippocampus in episodic memory and other cognitive functions. Many fascinating facets have emerged. For instance, place cells in the hippocampus respond selectively to certain locations in space and their spiking is controlled by a number of brain rhythms. Neurons in the input fire spikes in a hexagonal grid pattern. Although a "standard framework" has come to dominate the design and interpretation of the vast majority of experimental and theoretical studies, the computational role of the hippocampus remains elusive. The core assumption of the standard framework is that cortical inputs drive rapid synaptic plasticity to imprint memories as new attractor states in CA3. Other areas of the hippocampus are assigned supporting roles such as pattern separation in the dentate gyrus (DG). While other models offer alternative hypotheses to the standard framework, they mostly share the view that memories are, at least initially, stored in the recurrent CA3 connections. The experimental evidence in support of the standard framework is considerable, however, a number of contradictory results suggest that CA3 might not be the site of rapid memory storage. For instance, rapid plasticity in CA3 is not required for single-trial learning, spatial learning in the Morris water maze, and in trace conditioning, although these tasks are core tests of hippocampal function. This symposium brings together experimentalists and theorists to discuss the various models of hippocampal function and the supporting experimental evidences. The invited speakers have all done both experimental as well as theoretical research on the hippocampus. They are in an excellent position to keep the discussion focused on computational models that are firmly grounded in experimental results without being tied to fine details of experimental procedures. It is hoped that the speakers will present contrasting views that will lead to a lively discussion. This symposium will summarize recent, and potentially synthesize new insights into the principles of hippocampal function.

Symposium 3

Wednesday, March 13, 2013
15:00 – 18:00, Lecture Hall 10

Chair: Sen Cheng and Laurenz Wiskott, Bochum

15:00 **Opening Remarks**

15:05 Edmund Rolls, Oxford and Warwick, UK
A THEORY OF HIPPOCAMPAL FUNCTION, AND HOW IT INCORPORATES SPATIAL VIEW CELLS IN PRIMATES AND PLACE CELLS IN RODENTS (S3-1)

15:35 Sen Cheng, Bochum
THE CRISP THEORY OF HIPPOCAMPAL FUNCTION IN EPISODIC MEMORY (S3-2)

16:05 Torsten Neher, Bochum
ARE MEMORIES REALLY STORED IN THE HIPPOCAMPAL CA3 REGION? (S3-3)

16:20 **Coffee Break**

16:40 Francesco Battaglia, Nijmegen, The Netherlands
NEURAL OSCILLATIONS, BEHAVIOR, AND INTERACTION WITHIN THE HIPPOCAMPAL FORMATIONS AND BETWEEN CORTEX AND HIPPOCAMPUS (S3-4)

17:10 Antje Kilias, Freiburg
SUSTAINED PHASE COUPLING OF HIPPOCAMPAL SINGLE CELL FIRING TO NETWORK OSCILLATIONS UNDER EPILEPTIC CONDITIONS (S3-5)

17:25 Neil Burgess, London, UK
NEURAL MECHANISMS OF SPATIAL COGNITION (S3-6)

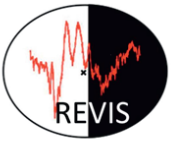
17:55 **Concluding Remarks**

Introductory Remarks to Symposium 4

Non-invasive brain stimulation: mechanisms, effects and opportunities

Petra Henrich-Noack, Bernhard Sabel and Michael A. Nitsche, Magdeburg and Göttingen

Non-invasive brain stimulation (NIBS) allows to explore and modulate brain (patho)physiology in basic research and clinical applications. Having evidence for its functional efficacy, it is of increasing importance to describe the underlying mechanisms to develop tailored stimulation protocols for hypothesis-driven alterations of brain function in health and disease. M. Nitsche (Clin. Neurophysiology; Göttingen) will show data about the physiological basis of NIBS, including effects on neuronal populations and networks. E. Sergeeva (Otto-von-Guericke University, Magdeburg) will present results from alternating current (AC) stimulation via the eye which is successfully used for rehabilitation and protection after visual system damage. In animal models the underlying mechanisms can be revealed on a cellular and functional level considering the various structures of the visual system. High resolution computational modelling is suited to determine physical characteristics of current flow induced by NIBS, including the influence of skull anatomy, idiosyncratic folding and brain lesions, which is another important factor for the efficacy of stimulation (M. Bikson; The City University of New York). The focus of P. M. Rossini´s (Catholic University of Rome) work is (post-lesional) neuronal plasticity/ cognition: transcranial magnetic stimulation (TMS) allows determining the influence of brain structures on cognitive tasks or rehabilitation. Moreover, TMS can alter neuronal excitability and result in long-lasting plasticity with impact on cognition and behaviour. Finally, the TMS/EEG allows investigating brain connectivity in vivo in health and disease. S. Schmidt (Charité, Berlin) combines neuronavigated TMS and transcranial direct current stimulation (tDCS) for a better understanding of NIBS-induced alterations of brain function and a more effective treatment of visual and motor impairments.



Restoration of Vision after Stroke
ERA-NET NEURON Project

Symposium 4

Wednesday, March 13, 2013
15:00 – 18:00, Lecture Hall 9

Chair: Petra Henrich-Noack, Bernhard Sabel and Michael Nitsche, Magdeburg and Göttingen

15:00 **Opening Remarks**

15:05 Michael A. Nitsche, Göttingen
PHYSIOLOGICAL BACKGROUND OF THE EFFECTS OF NON-INVASIVE BRAIN STIMULATION (S4-1)

15:30 Elena G. Sergeeva, Magdeburg
MECHANISMS OF NEUROPROTECTION AND NEUROPLASTICITY AFTER REPETITIVE TRANSORBITAL ALTERNATING CURRENT STIMULATION (S4-2)

15:55 Marom Bikson, New York, USA
TARGETING OF TRANSCRANIAL DIRECT CURRENT STIMULATION (S4-3)

16:20 **Coffee Break**

16:35 Sein H. Schmidt, Berlin
GETTING THE RIGHT SITE, CAN NAVIGATION HELP US ACCESS NON-PRIMARY MOTOR AREAS: A SHAM-CONTROLLED SERIAL NAVIGATED TMS STUDY (S4-4)

17:00 Paolo Maria Rossini, Rome, Italy
BRAIN PLASTICITY AND CONNECTIVITY IN NEUROLOGICAL DISEASES: THE TMS CONTRIBUTION (S4-5)

17:25 Andres Agudelo-Toro, Göttingen
A TOOL FOR THE SIMULATION OF THE ELECTRICAL ACTIVITY OF REALISTIC NEURON MORPHOLOGIES IN A CONDUCTIVE EXTRACELLULAR SPACE (S4-6)

17:40 Leon Morales-Quezada, Boston, USA
EFFICACY OF NON-INVASIVE CORTICAL STIMULATION: APPLICATIONS IN NEURO-REHABILITATION AND COMBINATION WITH TRAINING PROTOCOLS (S4-7)

17:55 **Concluding Remarks**

Introductory Remarks to Symposium 5

"The paradox of the critical period" – rejuvenating cortical networks

Siegrid Löwel and Fred Wolf, Göttingen

Sensitive periods also called critical periods are a fundamental characteristic of neocortical processing in the juvenile brain. In sensory cortices, critical periods of high susceptibility to experience-driven reorganization of cortical architecture often last for many weeks and even for years after birth in the human brain. It is widely assumed that in normal development, critical period plasticity sub-serves the function of constructing and optimizing cortical processing architectures and that it would be beneficial to reinstate juvenile plasticity in the adult or aging brain to enable restoration of cortical function after insult and disease. However, direct demonstrations of such constructive functions of juvenile plasticity as well as rational approaches to rejuvenate the adult brain remained elusive for decades. Commenting on this, Jack Pettigrew once called it the "paradox of the critical period" … it „seems to provide only little benefit compared with its great potential for handicap" (1978)[1]. Over the past several years, this picture has fundamentally changed. Studies in sensory cortices have uncovered a multitude of constructive long-term processes that rearrange cortical architectures over the entire duration of the critical period. They include reorganization to achieve interareal matching of cortical architecture[2], to maintain functional organization in the face of postnatal cortical growth[3] and the long-term reshaping of response properties by extended periods of sensory experience[4-8]. In addition, a multitude of new strategies for rejuvenating cortical networks has been suggested recently[9-11]. The symposium *"The paradox of the critical period" – rejuvenating cortical networks* puts a focus on researchers who made important contributions to uncovering the long-sought constructive power of critical period plasticity and who pioneered rational strategies for restoring plasticity in adult and diseased brains. Two complementary sessions will present and discuss recent insights into the progressive reorganization in the juvenile visual cortex and novel approaches to reinstate juvenile-like levels of plasticity in adult and aging cortex.

[1]Pettigrew (1978) In: Neuronal Plasticity, ed Cotman (Raven Press, NY), p 311; [2]Kaschube et al (2009) PNAS 106:17205; [3]Keil et al (2010) PNAS 107:12293; [4]Li et al (2008) Nature 456:952; [5]Wang et al (2010) Neuron 65:246; [6]Rochefort et al (2011) Neuron 71:425; [7]Berkes et al (2011) Science 331:83; [8]Kremer et al (2011) JNS 31:10689; [9]Bavelier et al (2010) JNS 30:14964; [10]Medini & Pizzorusso (2010) Front Biosci 13:3000; [11]He et al (2007) Nat Neurosci 10:1134.

Symposium 5

Wednesday, March 13, 2013
15:00 – 18:00, Lecture Hall 104

Chair: Siegrid Löwel and Fred Wolf, Göttingen

15:00 **Opening Remarks**

15:05 Nathalie Rochefort, München and Edinburgh, UK
DEVELOPMENT OF ORIENTATION AND DIRECTION SELECTIVITY IN MOUSE VISUAL CORTEX NEURONS IN VIVO (S5-1)

15:30 Jianhua Cang, Evanston, USA
CRITICAL PERIOD PLASTICITY AND BINOCULAR MATCHING IN THE VISUAL CORTEX (S5-2)

15:55 Juan Daniel Flórez Weidinger, Göttingen
ACTIVE SELF-ORGANIZATION OF A DISORDERED ARRANGEMENT OF ORIENTATION PREFERENCE IN THE VISUAL CORTEX (S5-3)

16:10 **Coffee Break**

16:30 Daphne Bavelier, Rochester, USA and Geneva, Switzerland
ACTION VIDEO GAMES AS EXEMPLARY LEARNING TOOLS (S5-4)

16:55 Tommaso Pizzorusso, Pisa, Italy
MOLECULAR CONTROL OF OCULAR DOMINANCE PLASTICITY (S5-5)

17:20 Elizabeth M. Quinlan, College Park, USA
NARP-DEPENDENT RECRUITMENT OF INHIBITION REVERSIBLY REGULATES THE CRITICAL PERIOD FOR OCULAR DOMINANCE PLASTICITY (S5-6)

17:45 Franziska Greifzu, Göttingen
ENVIRONMENTAL ENRICHMENT EXTENDS OCULAR DOMINANCE PLASTICITY IN MOUSE VISUAL CORTEX INTO ADULTHOOD AND PROTECTS FROM STROKE-INDUCED REDUCTIONS OF PLASTICITY (S5-7)

Introductory Remarks to Symposium 6

Mouse models in hearing research: unraveling auditory processing from molecules to behaviour

Simone Kurt and Jutta Engel, Ulm and Homburg/Saar

The sense of hearing is the most vulnerable sensory system. Hearing aids or cochlear implants do not fully restore auditory functions such as speech perception in noise or localizing sound sources, which is partly caused by our limited understanding of the function of molecules, cells and circuits in normal auditory function. In the past 15 years, linkage analyses of deafness genes in humans and the characterization of mutant and transgenic mouse models have provided us with many insights into normal hearing and the causes of hearing loss but many questions remain unresolved.

Ulrich Müller (The Scripps Research Institute, La Jolla, USA) will report on the use of various genetic mouse models to identify molecular components involved in hair cell mechanotransduction. In inner hair cells, the presumptively multifunctional protein otoferlin is indispensible for exocytosis. Nicola Strenzke (Dept. of Otolaryngology, University of Göttingen) will present the effects of different otoferlin mutations on hearing function. The presynaptic protein Bassoon is important in synaptic transmission not only at the inner hair cell synapse, but also at the auditory nerve synapse at the endbulb of Held, which will be reported by Alejandro Mendoza Schulz (Dept. of Otolaryngology, University of Göttingen). Marlies Knipper (THRC, University of Tübingen) will focus on the use and value of conditional mouse models for elucidating the feedback crosstalk between the peripheral and the central auditory system.

To investigate coding and manipulation of neuronal activity patterns in the auditory cortex, Juliane Tinter (Research Institute of Molecular Pathology, Vienna) uses an optogenetic approach. She will present results from mice virally transfected with channelrhodopsin-2, which allows optical cortical stimulation in a behavioural go/nogo task. Simone Kurt (Institute of Neurobiology, Ulm University) and Jutta Engel (Dept. of Biophysics, Saarland University) will report on a mouse model deficient for the Ca^{2+} channel subunit $\alpha_2\delta 3$ normally expressed in spiral ganglion and auditory brainstem neurons which shows altered auditory processing up to the behavioural level.

Symposium 6

Wednesday, March 13, 2013
15:00 – 18:00, Lecture Hall 8

Chair: Simone Kurt and Jutta Engel, Ulm and Homburg/Saar

15:00 **Opening Remarks**

15:05 Ulrich Müller, La Jolla, USA
THE SOUND OF SILENCE: DEFECTS IN HAIR CELL MECHANOTRANSDUCTION THAT CAUSE DEAFNESS (S6-1)

15:35 Nicola Strenzke, Göttingen
EFFECTS OF MUTATIONS IN OTOFERLIN ON HEARING FUNCTION (S6-2)

16:05 Alejandro Mendoza Schulz, Göttingen
THE ROLE OF THE PRESYNAPTIC SCAFFOLD PROTEIN BASSOON IN SYNAPTIC TRANSMISSION AT THE MOUSE ENDBULB OF HELD (S6-3)

16:20 **Coffee Break**

16:45 Marlies Knipper, Tübingen
SOUND CODING THROUGH FEEDBACK CROSSTALK BETWEEN THE PERIPHERAL AND CENTRAL AUDITORY SYSTEM: LEARNING FROM CONDITIONAL MOUSE MODELS (S6-4)

17:15 Juliane Tinter, Vienna, Austria
OPTOGENETIC MANIPULATION OF NEURONAL ACTIVITY PATTERNS IN THE MOUSE AUDITORY CORTEX IN THE CONTEXT OF A GO/NOGO TASK (S6-5)

17:30 Simone Kurt and Jutta Engel, Ulm and Homburg/Saar
DISTORTED HEARING IN MICE LACKING THE $\alpha_2\delta 3$ CA^{2+} CHANNEL SUBUNIT – A MODEL FOR AN AUDITORY PROCESSING DISORDER (S6-6)

Introductory Remarks to Symposium 7

Functional organization of presynaptic neurotransmitter release sites

Eckart Gundelfinger and Anna Fejtova, Magdeburg

Accurate and reliable synaptic transmission is of critical importance for normal brain function. The symposium will address mechanisms of spatial and temporal control of neurotransmitter release and discuss recent progress in our mechanistic and molecular understanding of this process. What are the functional specializations allowing evoked high-frequency transmission at central synapses? Stefan Hallermann will discuss adaptations of the presynaptic exocytotic machinery to allow release with high speed and reliability. Two essential steps – loading of vesicular release sites and coupling of calcium channels to sensors of exocytosis – will be addressed. The docking and priming of secretory vesicles in chromaffin cells are the topic of Heidi de Wit's talk. She will focus on molecular aspects of assembly of SNARE complexes and the regulation by Munc18.
The symposium will include two young investigators: Özgür Genç will illuminate the role of PKC-driven phosphorylation of Munc18 in short-term presynaptic potentiation in the Calyx of Held. Cordelia Imig will present her study on the role of CAPS and Munc13 in docking and priming of synaptic vesicles employing a fixative-free electron microscopy approach.
A critical determinant of release efficacy is the coupling of the release apparatus to presynaptic calcium channels. Using a mathematic model based on ultra-structural data Ralf Schneggenburger has explored how the precise localization and stoichiometry of these channels relative to release sites influences the characteristics of transmitter release in the Calyx of Held. Anna Fejtova will report on differential recruitment mechanisms for calcium channel subtypes to presynaptic release sites and how the differential channel coupling contributes to presynaptic plasticity. Finally, Stephan Sigrist's lab employed live- and high-resolution-imaging techniques to investigate the molecular organization of release sites in Drosophila neuromuscular junctions. They disclosed a dual role for presynaptic T-bars in the recruitment of synaptic vesicles to the release sites and their physical coupling to calcium channels.

This symposium is organized in cooperation with the Study Group 'Molecular Neurobiology' (Speaker: Prof. Rolf Heumann, Bochum) of the Gesellschaft für Biochemie und Molekularbiologie.

GBM

Symposium 7

Thursay, March 14, 2013
9:00 – 12:00, Lecture Hall 10

Chair: Eckart Gundelfinger and Anna Fejtova, Magdeburg

09:00 **Opening Remarks**

09:05 Stefan Hallermann, Göttingen
MECHANISMS OF KHZ-TRANSMISSION AT A CENTRAL SYNAPSE (S7-1)

09:30 Heidi de Wit, Amsterdam, The Netherlands
MOLECULAR CHARACTERIZATION OF THE MINIMAL DOCKING MACHINERY FOR SECRETORY VESICLE EXOCYTOSIS IN CHROMAFFIN CELLS (S7-2)

09:55 Özgür Genç, Lausanne, Switzerland
A TRANSIENT PHOSPHORYLATION OF MUNC18 BY PKC UNDERLIES POST-TETANIC POTENTIATION OF TRANSMITTER RELEASE (S7-3)

10:10 **Coffee Break**

10:25 Cordelia Imig, Göttingen
ULTRASTRUCUTRAL AND FUNCTIONAL ANALYSIS OF SYNAPTIC VESICLE DOCKING AND PRIMING (S7-4)

10:40 Ralf Schneggenburger, Lausanne, Switzerland
CONTROL OF FAST TRANSMITTER RELEASE BY MULTIPLE CA^{2+} CHANNELS REFLECTS A NON-RANDOM SPATIAL ORGANIZATION OF CHANNELS AND VESICLES (S7-5)

11:05 Anna Fejtova, Magdeburg
ROLE OF THE CYTOMATRIX AT THE ACTIVE ZONE IN THE ORGANIZATION OF PRESYNAPTIC RELEASE SITES (S7-6)

11:30 Stephan Sigrist, Berlin
SHEDDING LIGHT ON THE FUNCTIONAL ANATOMY OF PRESYNAPTIC ACTIVE ZONES (S7-7)

11:55 **Concluding Remarks**

Introductory Remarks to Symposium 8

Neurochemical control of social behaviour in insects

Paul A. Stevenson and Ricarda Scheiner, Leipzig and Potsdam

Insect brains are comparatively simple in terms of neuron number, they nonetheless have the integrative power to sculpture social interactions of a complexity approaching our own. This is achieved to a great extent via the neuromodulatory action of biogenic amines. Amines can mediate influences of previous and momentary experiences on social behaviour, often by signaling rewarding and aversive attributes. The neuronal representation of such attributes may underlie the control of aggression, repulsion or attraction and structure social systems. The symposium speakers exploit pharmacological, molecular biological and elegant genetic techniques to reveal basic principles of how neuromodulators forge insect social behaviour. Sarah Certel has uncovered how octopamine, contained within identified neurones that express the sex determining gene product fruitless, controls the choice between aggression and courtship in Drosophila. Paul Stevenson and Jan Rillich's work is revealing the role of octopamine and other modulators in mediating the effect of a wide variety of experiences on aggression in crickets. Swidbert Ott has shown how social contact in locusts recruits serotonin-coupled second messenger pathways to invoke the behavioural change from avoidance to social tolerance, the prerequisite for swarming. Work on honey bees by Vanina Vergoz illustrates how the queen mandibular pheromone (QMP) and its major component homovanillyl alcohol, a metabolite of dopamine, maintains reproductive hegemony of the queen by suppressing ovarian development by activating specific dopamine receptors. Finally, Ricarda Scheiner, again on honeybees, is making new contributions towards understanding the relationships between biogenic amine systems, sensory response thresholds and division of labour. These insights from diverse model systems form a synopsis of current understanding of how social behaviour is controlled in insects (Support by the DFG is greatly appreciated).

Symposium 8

Thursday, March 14, 2013
9:00 – 12:00, Lecture Hall 8

Chair: Paul A. Stevenson and Ricarda Scheiner, Leipzig and Potsdam

09:00 **Opening Remarks**

09:05 Sarah J. Certel, Missoula, USA
OCTOPAMINE NEUROMODULATION REGULATES THE GR32A PATHWAY TO PROMOTE AGGRESSION IN DROSOPHILA MALES (S8-1)

09:30 Jan Rillich, Berlin
EXPERIENCE DEPENDENT PLASTICITY OF AGGRESSION IN CRICKETS AND ITS CONTROL BY NEUROMODULATORS (S8-2)

09:55 Swidbert Roger Ott, Cambridge, UK
SEROTONERGIC SIGNALLING PATHWAYS AND THE CONTROL OF PHASE CHANGE AND SWARMING IN DESERT LOCUSTS (S8-3)

10:20 **Coffee Break**

10:50 Vanina Vergoz, Sydney, Australia
THE QUEEN, HER PHEROMONES AND REPRODUCTIVE HEGEMONY IN HONEY BEES (S8-4)

11:15 Ricarda Scheiner, Potsdam
BIOGENIC AMINES AND MECHANISMS CONTROLLING THE DIVISION OF LABOR IN A HONEYBEE SOCIETY (S8-5)

11:40 Daniel Rolke, Potsdam
SPATIAL AND TEMPORAL EXPRESSION PATTERNS OF SEROTONIN RECEPTOR SUBTYPES IN THE HONEYBEE, *APIS MELLIFERA* (S8-6)

11:55 **Concluding Remarks**

Introductory Remarks to Symposium 9

Timescales in neuronal population encoding and their biophysical basis

Andreas Neef, Göttingen

How do the spikes of a population of neurons encode a stimulus? What are the contributions of different ion channels on the encoding in individual neurons and how does the interaction of excitatory and inhibitory neurons in the network shape the population's response? These are questions we want to explore in this symposium.

Recent years saw rapid progress in the characterization of the different time scales involved in neural response dynamics. On the fast end of the spectrum, the population firing rate can change within few milliseconds after a change in the input, a feature that is related to the high frequency end of the dynamic range of neurons that can extend to around 200 Hz (Lundstrom et al. 2008, Tchumatchenko et al. 2011). While a fast response had been predicted for the simplified integrate-and-fire model neurons (Brunel et al. 2001), seemingly more appropriate and more complex neuron models do not show this immediate response (Fourcaud-Trocmé et al. 2003). Several of the speakers of this symposium contributed to the characterization the fast response in experimental and theoretical studies and revealed its importance for information processing. In this symposium they will also address slower time scales of neural encoding. Recent studies highlight, how specific ion channels tune the spike generation to adapt the neural response over many milliseconds to seconds, and how this adaptation assures a high dynamic range for the encoding of stimuli.

Although studies of stimulus encoding go back decades, new standards of experimental design and analysis are still forming. In the symposium recordings from neurons in sensory areas are presented, obtained in-vitro as well as in-vivo under behaviourally relevant stimulation of the animal. Another line of experiments manipulate neurons pharmacologically to identify the biophysical basis of adaptation and one line of experiments aims at largely automated characterization of individual neurons. The symposium will be part of the lively exchange between theory and experiment that energizes the field of neural population encoding.

Symposium 9

Thursday, March 14, 2013
9:00 – 12:00, Lecture Hall 9

Chair: Andreas Neef, Göttingen

09:00 **Opening Remarks**

09:05 Fred Wolf, Göttingen
BRUCE KNIGHT'S PERFECT ENCODER AND THE UNSOLVED PROBLEM OF ACTION POTENTIAL INITIATION (S9-1)

09:30 Ilan Lampl, Rehovot, Israel
SHORT-TERM SYNAPTIC PLASTICITY SHAPES THE BALANCE BETWEEN EXCITATION AND INHIBITION DURING ONGOING CORTICAL ACTIVITY (S9-2)

09:55 Adrienne L. Fairhall, Seattle, USA
MULTIPLE TIMESCALES OF INFORMATION REPRESENTATION IN NEURONS AND NETWORKS (S9-3)

10:20 **Coffee Break**

10:35 Adrian Klein, Bonn
THE ACTIVITY OF MEDULLARY LATERAL LINE UNITS OF COMMON RUDD, *SCARDINIUS ERYTHROPTHALMUS,* WHICH WERE EXPOSED TO KÁRMÁN VORTEX STREETS (S9-4)

10:50 Matthew H. Higgs, Seattle, USA
K^+ CHANNELS AFFECT CORTICAL NEURON INPUT ENCODING ON MULTIPLE TIME SCALES (S9-5)

11:15 Ahmed El Hady, Göttingen
NON-INVASIVE CHARACTERIZATION OF INDIVIDUAL NEURONS' COMPUTATIONAL PROPERTIES USING CONTINUOUS DYNAMIC PHOTO-STIMULATION (S9-6)

11:30 Clemens Boucsein, Freiburg
THE BEST FROM TWO WORLDS: NEOCORTICAL NEURONS AS INTEGRATORS WITH PRECISE SPIKE TIMING (S9-7)

11:55 **Concluding Remarks**

Introductory Remarks to Symposium 10

Differential brain science: towards an understanding of interindividual variation

Axel Kohler and Erhan Genç, Münster and Bochum

Since the advent of modern brain-imaging techniques, research in cognitive neuroscience has mainly relied on group analysis of imaging data, comparing average responses in multiple conditions within a group or comparing patterns across groups. In recent years, a number of researchers have started to exploit variation among individuals as a new window into brain function. The differential approach correlates interindividual differences in dependent measures with certain characteristics of the individual brains. The dependent measures can range from objective assessments of functional activity to subjective reports on conscious perception and personal attitudes. The variance in these variables is tested against structural and functional features of the brain, including gray-matter density, cortical thickness, brain-region size, white-matter microstructure, the distribution of neurochemicals, and resting-state functional activation.

The topics covered by the invited speakers range from the motor domain, over musical expertise and synesthesia, to auditory processing and conscious visual experience. An important theme in some of the talks will be interhemispheric connections through the corpus callosum and their specific influence on integration and segregation between the two halves of the brain. Despite a long tradition of research on the corpus callosum, the physiological mechanisms of interhemispheric communication are still not well known. The understanding of interactions between the brain hemispheres is of particular importance for human neuroscience, since hemispheric segregation and the resulting lateralization of functions is specifically pronounced in humans. But also intrahemispheric mechanisms will be considered in some of the presentations, providing first insights on how local brain features are shaped by experience and, in turn, determine behaviour. The human studies will be complemented by a talk on the genetic basis of pain-related learning in fruit flies.

The aim of the symposium is to give an overview of current research on interindividual differences in brain structure and function. It will also provide a platform to discuss the benefits and possible drawbacks of the approach, resulting in a state-of-the-art account of the emerging picture of the individual brain.

Symposium 10

Thursday, March 14, 2013
9:00 – 12:00, Lecture Hall 104

Chair: *Axel Kohler and Erhan Genç, Münster and Bochum*

09:00 **Opening Remarks**

09:05 Ulf Ziemann, Tübingen
DIFFERENTIAL BRAIN SCIENCE IN THE HUMAN SENSORIMOTOR CORPUS CALLOSUM (S10-1)

09:30 Axel Kohler, Münster
INTERHEMISPHERIC CONNECTIONS SHAPE INDIVIDUAL CONSCIOUS EXPERIENCE OF VISUAL ILLUSIONS (S10-2)

09:55 Erhan Genç, Bochum
SURFACE AREA OF EARLY VISUAL CORTEX PREDICTS INDIVIDUAL SPEED OF TRAVELING WAVES DURING BINOCULAR RIVALRY (S10-3)

10:10 René Westerhausen, Bergen, Norway
ON THE RELEVANCE OF INTER-INDIVIDUAL CALLOSAL DIFFERENCES FOR BEHAVIOUR AND EXPERIENCE (S10-4)

10:35 **Coffee Break**

10:55 Ryota Kanai, Sussex, UK
BRAIN STRUCTURE CORRELATES OF INDIVIDUAL DIFFERENCES IN PERCEPTUAL RIVALRY (S10-5)

11:20 Mirjam Appel, Planegg/Martinsried
GENETIC ARCHITECTURE OF PUNISHMENT-, RELIEF-LEARNING AND SHOCK AVOIDANCE (S10-6)

11:35 Lutz Jäncke, Zurich, Switzerland
SPECIALISATION OF THE SPECIALISTS - THE NEUROSCIENCE OF INDIVIDUAL DIFFERENCES (S10-7)

Introductory Remarks to Symposium 11

Serotonin: from brain development to behaviour - new insights from animal models

Natalia Alenina and Christian P. Müller, Berlin and Erlangen

Serotonin (5-hydroxytryptamine, 5-HT) is a key modulatory neurotransmitter in the central nervous system (CNS). Neurons producing 5-HT exhibit a wide innervation throughout the CNS already at early stages of neurogenesis and serotonin is thought to have major impact on brain development in mammals.

Serotonin synthesis in the brain is restricted to a very limited number of cells in the dorsal raphe nuclei with a vast axonal network innervating most other areas in the brain and spinal cord. TPH2 is the brain-specific isoform of the enzyme responsible for the initial and rate-limiting step in serotonin biosynthesis. The extracellular level of 5-HT is primarily regulated by the 5-HT transporter (Slc6a4; SERT), which reuptakes 5-HT from the extracellular space into the presynaptic neuron where it can be degraded or retained for future release. SERT is a target of most frequently prescribed antidepressants and anxiolytics in human and is thought to function as a plasticity gene, increasing sensitivity to environmental stimuli.

In recent years several unprecedented animal models with altered serotonergic transmission were generated, including Tph2-deficient mice (animals which are completely devoid of brain serotonin), SERT-deficient rats and rats with lesions of specific cortical areas by serotonin-neuron specific toxin 5,7-dihydroxytryptamine (5,7-DHT). The present symposium is aiming to sum up the novel findings which have been gained by the phenotypical analysis of these models. The consequences of complete and partial serotonin deficiency on anxiety, aggression, sexual behaviour, sensomotor processing, and cocaine-induced reinforcement will be summarized. Furthermore, we will present the data showing association of serotonin transporter gene variations with adaptive and maladaptive behavioural responses and with manifestations of autism, with focus on communication deficits based on the analysis of ultrasonic vocalization in SERT-deficient animals. Moreover, using the unique Tph2::eGFP knockin mouse model we will show how 5-HT synthesis abrogation affects specific morphogenetic activities during foetal and early postnatal CNS development.

Symposium 11

Thursday, March 14, 2013
9:00 - 12:00, Lecture Hall 105

Chair: Natalia Alenina and Christian P. Müller, Berlin and Erlangen

09:00 **Opening Remarks**

09:05 Massimo Pasqualetti, Pisa, Italy
LACK OF BRAIN SEROTONIN AFFECTS POSTNATAL DEVELOPMENT AND SEROTONERGIC NEURONAL CIRCUITRY FORMATION (S11-1)

09:30 Natalia Alenina, Berlin
BEHAVIORAL AND PHYSIOLOGICAL CONSEQUENCES OF CENTRAL 5-HT DEFICIENCY IN MICE (S11-2)

09:55 Christian P. Müller, Erlangen
ROLE OF CORTICAL SEROTONIN FOR SENSOMOTOR PROCESSING, ANXIETY AND REINFORCEMENT (S11-3)

10:20 **Coffee Break**

10:35 Judith Homberg, Nijmegen, The Netherlands
EARLY LIFE ADVERSITY AND SEROTONIN TRANSPORTER GENE VARIATION INTERACT TO SHAPE THE ADULT HYPOTHALAMO-PITUITARY-ADRENAL AXIS AND STRESS ESCAPE BEHAVIOUR (S11-4)

11:00 Markus Wöhr, Marburg
ULTRASONIC COMMUNICATION AND SOCIAL BEHAVIOURS IN RATS LACKING THE SEROTONIN TRANSPORTER (S11-5)

11:25 Stephanie Miceli, Nijmegen, The Netherlands
CORTICAL HYPERCONNECTIVITY ASSOCIATED WITH OVEREXPOSURE TO 5-HT DURING BRAIN DEVELOPMENT (S11-6)

11:40 Valentina Mosienko, Berlin
BEHAVIORAL AND NEUROCHEMICAL CONSEQUENCES OF SUBTLE REDUCTION IN CENTRAL SEROTONIN PRODUCTION IN MICE (S11-7)

11:55 **Concluding Remarks**

Introductory Remarks to Symposium 12

Cytoskeletal dynamics in neuronal migration

Marco Rust and Walter Witke, Kaiserslautern and Bonn

During vertebrate brain development, neurons migrate from the germinal zone to their final laminar positions in order to establish functional circuits. Defects in cell migration contribute to various clinical conditions such as lissencephaly, mental retardation or epilepsy. Hence, it is important to understand the mechanisms underlying neuronal migration. Key insights into neuron migration were initially obtained in landmark studies identifying genes mutated in human cortical malformations, among them cytoskeletal components and their regulators. Recently, cell biology has greatly advanced our understanding of how cytoskeletal dynamics drive the morphogenic cell movements required for proper brain development. Neuronal migration is orchestrated through an intricate interplay between microtubules, actin, and associated motor proteins. This symposium highlights some important progress made over the past years in this field.

The first two speakers will provide insights into the mechanisms upstream of cytoskeletal dynamics that are relevant for directed migration of cerebellar granule neurons (CGN) in different model organisms. David Solecki will present his work on cell polarity pathways that regulate CGN exit from the germinal zone of the mouse cerebellum and on the control of nucleokinesis and somal translocation during glial-guided CGN migration. Reinhard Köster will focus on the mechanisms controlling migration of zebrafish CGN, which show a characteristic glial cell-independent manner of migration.

The other three talks will highlight the relevance of proteins controlling actin dynamics for CNS development and neuronal migration. Walter Witke will provide insights into the actin based mechanisms of cell migration with the F-actin depolymerizing proteins of the ADF/cofilin family as an example. This presentation will be supplemented by Michael Frotscher who will focus on signaling pathways controlling cofilin activity in migrating neurons and during layer formation in the cerebral cortex. Finally, Marco Rust will present a novel role for the G-actin binding protein profilin1 in glial cell-binding and radial migration of CGN.

Symposium 12

Thursday, March 14, 2013
9:00 – 12:00, Lecture Hall 102

Chair: Marco Rust and Walter Witke, Kaiserslautern and Bonn

09:00 **Opening Remarks**

09:05 David J. Solecki, Memphis, USA
NEURONAL MIGRATION ILLUMINATED: A LOOK UNDER THE HOOD OF THE LIVING NEURON (S12-1)

09:35 Reinhard Köster, Braunschweig
IMAGING OF NEURONAL MIGRATION IN ZEBRAFISH (S12-2)

10:05 Walter Witke, Bonn
THE ADF/COFILIN FAMILY OF ACTIN BINDING PROTEINS IN NEURONAL MIGRATION AND CORTICAL DEVELOPMENT (S12-3)

10:35 **Coffee Break**

10:55 Michael Frotscher, Hamburg
REELIN-INDUCED COFILIN PHOS-PHORYLATION STABILIZES THE ACTIN CYTO SKELETON DURING THE MIGRATION OF CORTICAL NEURONS (S12-4)

11:25 Marco Rust, Kaiserslautern
THE ACTIN-BINDING PROTEIN PROFILIN1 IN GLIAL CELL BINDING AND RADIAL MIGRATION OF CEREBELLAR GRANULE NEURONS (S12-5)

11:55 **Concluding Remarks**

Introductory Remarks to Symposium 13

Olfactory learning: from insects to machines

Martin Paul Nawrot and Thomas Nowotny, Berlin and Brighton, UK

Insect olfaction has become a strong model for inquiries into perception and learning due to a number of factors. Insects readily learn associations between odors and rewards or odors and punishments, even though their olfactory system is much smaller than those of rats and mice, the predominant mammalian model systems. The smaller size, and presumably complexity, makes the insect system experimentally more accessible and computationally more tractable. At the same time, the principles of chemo-sensory information processing seem to be highly conserved across phyla, suggesting that much can be learned in the simpler invertebrate systems that will be relevant in higher animals. Here, we bring together a number of scientists working at the interface of experimental and theoretical approaches to the biology of olfactory learning and its application to technical challenges in bio-inspired machine learning and robotics. We start out with new insights into the biology of memory formation. Hiromu Tanimoto will discuss results on the functional networks involved in the formation of positive or negative memories after appetitive or aversive conditioning in the fruit fly. Martin Strube-Bloss will present how the associative strength measured at the level of single mushroom body output neurons is correlated with behavioral performance during memory retention across individual honeybees. These observations at the behavioral and the physiological level are direct inspiration for the computational and theoretical models that follow. Joachim Haenicke presents a neural network model for fast associative learning in the honeybee and Barbara Webb will explain how we gain additional insights from experimentation with neurally inspired robotic architectures. Ramon Huerta will close the session with bio-mimetic machine learning inspired by the olfactory system of insects.
This symposium makes a unique contribution to the field of learning and memory formation, exposing synergies between experimental and theoretical approaches to systems neuroscience. The speakers will present a combination of established methods and novel, if not speculative, ideas that can be inspiring for experienced researchers and young scientists alike.

Partially supported by the Bernstein Focus "Neuronal Basis of Learning: Insect Inspired Robots" (BMBF 01GQ0941)

Symposium 13

Friday, March 15, 2013
9:00 – 12:00, Lecture Hall 9

Chair: *Martin Paul Nawrot and Thomas Nowotny, Berlin and Brighton, UK*

09:00 **Opening Remarks**

09:05 Hiromu Tanimoto, Planegg/Martinsried
CIRCUITS FOR MEMORY FORMATION IN THE FLY BRAIN (S13-1)

09:30 Lisa Scheunemann, Berlin
DYNAMICS OF OFLACTORY MEMORY ACQUISITION IN DROSOPHILA MELANOGASTER (S13-2)

09:45 Martin Strube-Bloss, Jena
ENCODING OF ODOR-REWARD ASSOCIATION IN SINGLE MUSHROOM BODY OUTPUT NEURONS CORRELATES WITH BEHAVIORAL PERFORMANCE (S13-3)

10:10 **Coffee Break**

10:25 Joachim Haenicke, Berlin
A COMPUTATIONAL MODEL OF FAST ASSOCIATIVE LEARNING IN THE HONEYBEE (S13-4)

10:50 Pierre Junca, Gif-sur-Yvette, France
BEHAVIORAL AND GENETIC BASIS OF THERMAL AVERSIVE CONDITIONING IN HONEYBEES (S13-5)

11:05 Barbara Webb, Edinburgh, UK
ISSUES FOR ROBOT MODELS OF OLFACTORY LEARNING IN INSECTS (S13-6)

11:30 Ramon Huerta, San Diego, USA
ON THE EQUIVALENCE OF THE INSECT BRAIN AND ARTIFICIAL INTELLIGENCE FOR PATTERN RECOGNITION (S13-7)

11:55 **Concluding Remarks**

Introductory Remarks to Symposium 14

Molecular mechanisms and spreading of alpha-Synuclein pathology in the brain

Tiago Outeiro and Jochen Klucken, Göttingen and Erlangen

The misfolding and aggregation of specific proteins is a common neuropathological hallmark of many neurodegenerative disorders, including Alzheimer's, Parkinson's, and Huntington's diseases. Parkinson's disease (PD) is a progressive and devastating neurodegenerative disorder, affecting 1% of individuals over 60 years old. The clinical manifestations of PD include rigidity, resting tremor and bradykinesia and result from the loss of dopaminergic neurons that project from substantia nigra pars compacta (SNc) to the striatum. The main pathological hallmark of PD is the presence of cytoplasmic inclusions called Lewy bodies (LBs) composed primarily of apha-synuclein, a small protein (140 amino acids) that is natively unfolded and interacts with multiple proteins and lipids. Although its physiological function remains unclear, alpha-synuclein is clearly involved in the pathogenesis of PD. Three independent missense mutations in the alpha-synuclein gene (A30P, E46K and A53T) lead to the development of familial PD. In addition, early onset of PD can also be caused by duplications and triplications of the alpha-synuclein gene (SNCA). Finally, SNPs in the gene encoding for alpha-synuclein are among the strongest risk factors for the development of PD. Recently, the idea that neurodegenerative diseases associated with protein misfolding and aggregation could be considered prion-like disorders has emerged. In particular, the spreading of alpha-synuclein pathology is thought to contribute to the progression of neurodegeneration. Nevertheless, the molecular determinants underlying secretion, extracellular effects, and transmission of pathology are still unclear, and will be the focus of this symposium. Ultimately, the understanding of these molecular mechanisms might lead to the identification of novel targets for therapeutic intervention.

Symposium 14

Friday, March 15, 2013
9:00 – 12:00, Lecture Hall 105

Chair: *Tiago Outeiro and Jochen Klucken, Göttingen and Erlangen*

09:00 **Opening Remarks**

09:05 Richard Wade-Martins, Oxford, UK
α-SYNUCLEIN REGULATES DOPAMINE NEUROTRANSMISSION SPECIFICALLY IN SUSCEPTIBLE NEURONAL POPULATIONS: THE KEY TO PARKINSON'S PATHO-PHYSIOLOGY? (S14-1)

09:30 Jochen Klucken, Erlangen
AUTOPHAGY AND ALPHA-SYNUCLEIN AGGREGATION (S14-2)

09:55 Tiago Outeiro, Göttingen
α-SYNUCLEIN OLIGOMERIZATION AND NEURONAL DYSFUNCTION: INTRACELLULAR AND EXTRACELLULAR EFFECTS (S14-3)

10:20 **Coffee Break**

10:50 Kostas Vekrellis, Athens, Greece
INVESTIGATION OF THE MECHANISMS OF α-SYNUCLEIN SECRETION IN VIVO (S14-4)

11:15 Jia-Yi Li, Lund, Sweden
LONG-DISTANCE TRAFFICKING OF PARKINSON'S PATHOLOGY IN NEURONS (S14-5)

11:40 Patricia S. Guerreiro, Lisbon, Portugal
LRRK2 INTERACTS WITH α-SYNUCLEIN AND TAU AND IS PRESENT IN LEWY BODIES IN PARKINSON'S DISEASE (S14-6)

11:55 **Concluding Remarks**

Introductory Remarks to Symposium 15

Cortical connectivity of crossmodal interactions

Till Schneider and Brigitte Röder, Hamburg

In natural environments inputs of different sensory modalities convey both complementary and redundant information about the environment. Recent research has shown that perception, cognitive functions, and the control of action are shaped by crossmodal inputs. The integration of multiple sensory inputs requires large-scale cortical interactions between distant cortical areas processing the different sensory inputs. The neural mechanisms underlying these large-scale interactions are yet unknown. There are different methodological approaches to investigate interactions between distant brain areas, including invasive and non-invasive electrophysiological techniques, structural and functional brain imaging methods.
The speakers of this symposium will cover the role of large-scale interactions in different functional domains of crossmodal processing: audio-visual speech processing, perceptual processing and the control of action. The talks will cover behavioral and electrophysiological data from humans as well as recent results from functional and structural brain imaging methods. Luc Arnal will highlight the importance of oscillatory neuronal activity for crossmodal processing in audio-visual speech processing. Verena Buchholz will focus on spatial reference frames allowing for crossmodal interactions. Katja Fiehler will focus on visual-somatosensory interactions in both perception and action. And Toemme Noesselt will discuss how cortico-cortical interactions define multisensory perception. Furthermore two Young Investigator Talks will cover predictive coding in arbitrarily learned associations between visual and auditory perceptual features and touch localization under coordinate conflict.
The main focus of the proposed symposium is to uncover the functional and structural connectivity underlying crossmodal integration processes in humans. On a broader perspective, the presentations will provide a framework for the general neural mechanisms of cortico-cortical connectivity in the human brain.

This symposium was supported by DFG SFB 936, Multi-Site Communication in the Brain

Symposium 15

Friday, March 15, 2013
9:00 – 12:00, Lecture Hall 8

Chair: *Till Schneider and Brigitte Röder, Hamburg*

09:00 **Opening Remarks**

09:05 Toemme Noesselt, Magdeburg
HOW CHANGES IN CORTICAL CROSSTALK RELATE TO DIFFERENCES IN MULTISENSORY PERCEPTION (S15-1)

09:35 Verena Buchholz, Hamburg
SPATIAL SELECTIVITY OF CORTICAL RHYTHMS (S15-2)

10:05 Katja Fiehler, Gießen
VISUAL-SOMATOSENSORY INTERACTION FOR PERCEPTION AND ACTION (S15-3)

10:35 **Coffee Break**

10:55 Luc Arnal, New York, USA
PREDICTIVE MECHANISMS AND OSCILLATORY ORGANIZATION: THE CASE OF AUDIO-VISUAL SPEECH PROCESSING (S15-4)

11:25 Stephanie Badde, Hamburg
TOUCH LOCALIZATION UNDER COORDINATE CONFLICT (S15-5)

11:40 Abhilash Dwarakanath, Tübingen
DISENTANGLING CROSS-MODAL TOP-DOWN PREDICTIVE CONTROL BY ACTIVELY MANIPULATING ARBITRARILY LEARNED ASSOCIATIONS (S15-6)

11:55 **Concluding Remarks**

Introductory Remarks to Symposium 16

Growing up in the brain: how do axons find their way?

Victor Tarabykin, Berlin

Precise wiring of neural circuits depends on axon guidance to correct targets. The wiring pattern of neurons in every area of the brain is not random, but highly specific. While the number of neurons may be greater than we think, they appear to fall into a finite number of cell types, which are in turn connected with other types of neurons in a regular manner. During the last years an impressive body of data was accumulated on how neurons connect to each other during development to form the complex communication networks that underlie our thoughts, behaviors and emotions. A key step in this process is the navigation of axons as they locate their targets in distant regions of the brain. In the embryo, the growth of axons is guided by molecular signals that exert attractive or repulsive effects. On the other hand axons of distinct cell types have different capacity to response to the same external molecular signals. As development proceeds an axon of a certain neuron can change its responsiveness from attraction to repulsion or even became insensitive. The symposium aims at providing an update on mechanisms of cell type specific connectivity. Thus it will present recent progress in understanding the mechanisms controlling axonal navigation and formation of the complex communication networks that underlie our thoughts, behaviors and emotions. The first presentation by Till Marquardt will focus on the connectivity of spinal cord neurons. He will discuss recent progress on understanding the molecular mechanisms driving the assembly of functional neuromuscular circuitries during embryonic and postnatal development. The mechanisms controlling the motor neuron specification will be discussed by Andrea Huber Brösamle. Three other speakers will discuss cerebral cortex connectivity. Victor Tarabykin will present evidence that making the cortico-spinal tract is a default choice for a cortical projection neuron and will show examples how it is suppressed in neurons making cortico-cortical projections. The lecture by Katherine Kalil will highlight the role of the morphogen Wnt5a and calcium signaling in guiding cortico-spinal and callosal axons. The role of Semaphorins in midline axon guidance will be the main topic of the lecture by Fanny Mann. This symposium aims at providing exiting overview on various mechanism of axon navigation and circuit formation in different brain regions.

Symposium 16

Friday, March 15, 2013
9:00 – 12:00, Lecture Hall 10

Chair: Victor Tarabykin, Berlin

09:00 **Opening Remarks**

09:05 Till Marquardt, Göttingen
WHAT AXONS TELL EACH OTHER: AXON-AXON SIGNALING DURING PERIPHERAL NERVE AND CIRCUIT ASSEMBLY (S16-1)

09:35 Andrea Huber Brösamle, München
MICRORNA-9 PROMOTES THE SWITCH FROM EARLY-BORN TO LATE-BORN MOTOR NEURON POPULATIONS BY REGULATING ONECUT TRANSCRIPTION FACTOR EXPRESSION (S16-2)

10:05 Victor Tarabykin, Berlin
MOLECULAR CONTROL OF CORTICO-CORTICAL AXONAL NAVIGATION (S16-3)

10:35 **Coffee Break**

10:55 Katherine Kalil, Madison, USA
WNT/CALCIUM SIGNALING MEDIATES CORTICAL AXON GROWTH AND GUIDANCE (S16-4)

11:25 Fanny Mann, Marseille, France
CONNECTING LEFT AND RIGHT BRAIN: THE ROLE OF SEMAPHORINS IN MIDLINE AXON GUIDANCE (S16-5)

11:40 Swathi Srivatsa, Berlin
ROLE OF SIP1 IN ORCHESTRATING NEOCORTICAL CONNECTIVITY (S16-6)

11:55 **Concluding Remarks**

Introductory Remarks to Symposium 17

Heterogeneity of microglia

Uwe-Karsten Hanisch and Susanne Wolf, Göttingen and Berlin

Sentinel and immune functions of microglia require appropriate reactions upon infectious and non-infectious threats to the CNS. Indeed, microglia can commit to diverse reactive phenotypes. However, whether activated cells mount a homogeneous response or whether subsets conduct selective tasks is unknown. Microglia may not comprise a uniform cell type but rather vary by house-keeping duties and functional capacities during development and in emergency situations. Uwe-Karsten Hanisch (Göttingen) will report on the developmental reorganization of Toll-like receptor (TLR) systems in microglia and microglial responder subsets upon TLR and other receptor challenges. Rosa Chiara Paolicelli (Zurich) will show how microglia participate in the maturation and modelling of synaptic connections during normal postnatal development. Deficiency in CX3CR1 results in a transient reduction in microglia as well as an excess of weak excitatory synapses in the hippocampus, due to defective synaptic pruning and leading to long-term impairments resembling some features of autism spectrum disorders. Monica Carson (Riverside) will draw a link between developmental heterogeneity of microglial phenotypes and a regional regulation of synaptic maturation. Restricted to developmental windows, TREM2-dependent microglial functions modulate the ratio of excitatory to inhibitory synapses in response to bouts of systemic inflammation as well as in the normal CNS. Pre-, neo- and postnatal inflammatory events may determine the onset and/or exacerbation of neurodevelopmental disorders. Knut Biber (Freiburg) will address region-specific differences in microglial expression patterns corroborating the concept of distinct microglial phenotypes in the non-inflamed brain. In models of NMDA-induced excitotoxicity, microglia display region-specific influences on the survival of neurons in the hippocampal formation. Susanne Wolf (Berlin) will cover the current knowledge about interactions of microglia with brain tumor cells. A concluding remark will summarize the essentials pointing to an existence of microglial subpopulations with distinct portfolios of tasks in the healthy and the diseased CNS.

Symposium 17

Friday, March 15, 2013
9:00 – 12:00, Lecture Hall 102

Chair: Uwe-Karsten Hanisch and Susanne Wolf, Göttingen and Berlin

09:00 **Opening Remarks**

09:05 Uwe-Karsten Hanisch, Göttingen
MICROGLIAL RESPONDER SUBSETS UPON TLR CHALLENGES (S17-1)

09:35 Rosa Chiara Paolicelli, Zurich, Switzerland
SYNAPTIC PRUNING BY MICROGLIA: SCULPTING BRAIN CONNECTIVITY (S17-2)

10:05 Monica Carson, Riverside, USA
AGE-SPECIFIC HETEROGENEITY IN MICROGLIAL REGULATION OF SYNAPTIC MATURATION AND MAINTENANCE (S17-3)

10:35 **Coffee Break**

10:55 Knut Biber, Freiburg
REGIONAL HETEROGENEITY OF MICROGLIA AND MICROGLIAL RESPONSES (S17-4)

11:25 Susanne Wolf, Berlin
MICROGLIA/MACROPHAGE – GLIOMA INTERACTION (S17-5)

11:55 **Concluding Remarks**

Introductory Remarks to Symposium 18

Optodynamics of channels and receptors

Andrew Plested and Jana Kusch, Berlin and Jena

This symposium highlights new methods to monitor and control electrical signalling in the CNS using light.

Recently, many receptors and channels have been resolved in atomic detail. Dirk Trauner will show how these findings allow reprogramming of ligand-gated ion channels, G-protein coupled receptors, as well as voltage-gated ion channels, to respond to unnatural input signals such as light. The resulting hybrid photoreceptors, which incorporate synthetic photoswitches, can be used to optically control neurons with high precision.
Jana Kusch investigates neuronal HCN pacemaker channels and olfactory CNG channels using confocal patch-clamp fluorimetry. This method combines patch-clamp techniques with confocal fluorescence microscopy, allowing for parallel recording of ligand binding and ion channel activity.
Baron Chanda's lab studies the activation of voltage gated ion channels using spectroscopic methods, combined with electrophysiology and other techniques. He will present his latest research on the activation of sodium channels, probed with voltage clamp fluorimetry and chemical modification.
Teresa Giraldez has developed a library of fluorescent potassium channels, in order to study structural correlates of activation using FRET. Simultaneous electrical and optical recording of BK channels with fluorescent protein inserts allows resolution of transitions that couple calcium binding and voltage sensing to channel activation.
Eric Hosy presents three different super-resolution techniques (STED, PALM and U-PAINT) to study the organisation and the mobility of AMPA receptors inside the synapse. He shows that these receptors are not randomly distributed at synapses but structured in nanodomains. This structured distribution allows high-fidelity synaptic responses.
Viktoria Klippenstein will show a method for photocontrol of glutamate receptors, using unnatural amino acid cross-linkers. These experiments provide biophysical insight into receptor desensitization, and may prove useful for inactivating glutamate receptors in vivo using light.

Symposium 18

Friday, March 15, 2013
9:00 – 12:00, Lecture Hall 104

Chair: Andrew Plested and Jana Kusch, Berlin and Jena

09:00 **Opening Remarks**

09:05 Dirk Trauner, München
OPTOCHEMICAL GENETICS (S18-1)

09:30 Jana Kusch, Jena
PARALLEL RECORDING OF LIGAND BINDING AND ION CHANNEL ACTIVATION USING CONFOCAL PATCH-CLAMP FLUOROMETRY (S18-2)

10:00 Baron Chanda, Madison, USA
STRUCTURAL TRANSITIONS DURING VOLTAGE-DEPENDENT ACTIVATION OF SODIUM CHANNELS (S18-3)

10:25 **Coffee Break**

10:45 Teresa Giraldez, Santa Cruz de Tenerife, Spain
STATE DEPENDENT FRET REPORTS LARGE GATING-RING MOTIONS IN WHOLE BK CHANNELS AT THE MEMBRANE (S18-4)

11:15 Eric Hosy, Bordeaux, France
NANO-ORGANIZATION OF THE AMPA-RECEPTORS INSIDE THE SYNAPSE AND PHYSIOLOGICAL ROLE (S18-5)

11:45 Viktoria Klippenstein, Berlin
PHOTOINACTIVATION OF GLUTAMATE RECEPTORS USING A GENETICALLY ENCODED UNNATURAL AMINO ACID (S18-6)

Introductory Remarks to Symposium 19

GABAergic mechanisms in neurobiology of disease

Jochen C. Meier and Günter Schwarz, Berlin and Köln

Homeostatic regulation of excitation and inhibition – also known as 'E-I balance' – seems to be essential for normal brain function and behavior, and dysregulation of this balance is associated with a plethora of neurological disorders. GABA is the major 'inhibitory' neurotransmitter in the adult brain. Among others, it activates chloride permeable GABA type A receptors (GABA(A)Rs) which normally mediate inhibition of neuronal excitability. Earlier in development or in disease, however, GABA can effect excitation, depending on the chloride reversal potential and the resulting direction of chloride flow through the neuronal plasma membrane. Thus, GABA can be an excitatory or inhibitory neurotransmitter. Furthermore, GABA(A)Rs are found at both non-synaptic and postsynaptic sites, the latter depending on the availability of the scaffold protein gephyrin. Besides its function as a synaptic GABA(A)R anchoring protein, gephyrin is also essential for the biosynthesis of the molybdenum cofactor (MoCo), which in turn is required for detoxification of cellular metabolites. Thus, a complex pattern of intertwined disease mechanisms can emerge as both dysregulation of MoCo biosynthesis and deficits in GABAergic transmission can cause neurodegenerative and mood disorders. This symposium will shed light on the role of the balance between inhibition and excitation for health and disease. We will focus on neuronal chloride homeostasis and discuss disease-relevant mechanisms of gene expression and posttranscriptional as well as post-translational modification of corresponding gene products. Researchers and young investigators should therefore get together and debate on recent discoveries and advances in the field of neurodegenerative and mood disorders, and how novel therapies could look like.

Symposium 19

Saturday, March 16, 2013
8:30 – 11:30, Lecture Hall 10

Chair: *Jochen C. Meier and Günter Schwarz, Berlin and Köln*

08:30 **Opening Remarks**

08:35 Jean-Marc Fritschy, Zurich, Switzerland
GABA(A) RECEPTORS IN THE PATHOPHYSIOLOGY OF EPILEPSY (S19-1)

09:00 Eva Ruusuvuori & Kai Kaila, Helsinki, Finland
CYTOSOLIC CARBONIC ANHYDRASES IN THE CONTROL OF GABAERGIC EXCITATION AND FEBRILE SEIZURES (S19-2)

09:25 Martin Puskarjov, Helsinki, Finland
ACTIVITY-DEPENDENT CLEAVAGE OF KCC2 MEDIATED BY CALPAIN SUGGESTS A GENERAL MECHANISM FOR EROSION OF INHIBITION (S19-3)

09:40 **Coffee Break**

09:55 Jochen C. Meier, Berlin
RNA PROCESSING IN TEMPORAL LOBE EPILEPSY (S19-4)

10:20 Falko Fuhrmann, Bonn
OPTOGENETIC CONTROL OF HIPPOCAMPAL OSCILLATIONS BY STIMULATION OF MEDIAL SEPTAL PV^+ INTERNEURONS (S19-5)

10:35 Bernhard Lüscher, Penn State, USA
GABAERGIC CONTROL OF DEPRESSIVE AND ANTIDEPRESSIVE BRAIN STATES (S19-6)

11:00 Günter Schwarz, Köln
GEPHYRIN IN NEURODEGENERATIVE DISEASE (S19-7)

11:25 **Concluding Remarks**

Introductory Remarks to Symposium 20

Functional specializations of neuroglia as critical determinants of brain activity

Christine Rose and Frank Kirchhoff, Düsseldorf and Homburg

The human brain is an extraordinary complex structure, consisting of about 80 billion neurones connected by numerous synapses, and of an equal number of neuroglial cells. Each second, it conducts 10^{14} "arithmetic" operations, which are the basis for processes ranging from basic regulatory activity to learning, memory and cognition.
To be able to fulfill all tasks related to information input, processing and output, the major neuronal cell categories (sensory and principal neurones, interneurones and motoneurones) are highly specialized and functionally divided into subpopulations. The basic neuroglial cell classes are usually considered a homogeneous cell population, often only addressed as "the astrocyte" or "the oligodendrocyte". As such, they are generally attributed several essential functions. Astrocytes detect and respond to neuronal activity, they can affect neuronal performance, regulate the cerebral blood flow, take up glucose and supply the neighbouring neurones with energy metabolites. Oligodendrocytes enwrap neuronal axons with lipid-rich lamellae to enhance action potential propagation and to prevent electrical shortcuts. Other macroglial cells such as radial glia or NG2 cells can serve as neural stem cells, generating new neurons or oligodendrocytes, respectively, in the developing and the adult brain.
Recent research, however, provided compelling evidence that this picture might be entirely wrong. Glial cells are by no means homogeneous, but consist of various subpopulations, each equipped with a distinct repertoire of ion channels, receptors, transporters and other signalling components. Thereby, glial cells developed functional specializations to meet the specific requirements of distinct network circuits in different brain regions or developmental stages. These findings represent a fundamentally new concept of our understanding of how the brain works, putting glial cells into a prominent focus of attention.

Symposium 20

Saturday, March 16, 2013
8:30 – 11:30, Lecture Hall 104

Chair: Christine Rose and Frank Kirchhoff, Düsseldorf and Homburg

08:30 **Opening Remarks**

08:35 Yuji Ikegaya, Tokyo, Japan
SPATIOTEMPORAL ORGANIZATION OF ASTROCYTIC CALCIUM ACTIVITY (S20-1)

09:00 Gertrudis Perea, Cambridge, USA
ASTROCYTES MODULATE INFORMATION PROCESSING IN VISUAL CORTEX (S20-2)

09:25 Moritz Rossner, Göttingen
REGIONAL AND DYNAMIC MISEXPRESSION OF MYELIN-RELATED AND ASTROCYTE-SPECIFIC TRANSCRIPTS IN SHARP1/2 MOUSE MUTANTS (S20-3)

09:50 **Coffee Break**

10:05 Christine R. Rose, Düsseldorf
HETEROGENEITY OF GLIAL GLUTAMATE UPTAKE (S20-4)

10:30 Daniela C. Dieterich, Magdeburg
ROLE OF PROTEIN TRANSLATION FOR ASTROGLIAL HETEROGENEITY IN HIPPOCAMPAL AND CORTICAL ASTROCYTES (S20-5)

10:55 Kristina Lippmann, Berlin
ALTERED SYNAPTIC PLASTICITY AND RHYTHMIC OSCILLATIONS IN THE HIPPOCAMPUS FOLLOWING VASCULAR INJURY AND BLOOD-BRAIN BARRIER DYSFUNCTION (S20-6)

11:10 Anne C. Wolfes, Göttingen
MOLECULAR MECHANISMS OF ASTROCYTE VESICLE RELEASE AT SYNAPTIC INTERFACES (S20-7)

11:25 **Concluding Remarks**

Introductory Remarks to Symposium 21

Molecular mobility, a variable of neuronal communication

Martin Heine, Magdeburg

The reliability of signal transmission in chemical synapses is highly dependent on the structural alignment between pre- and postsynaptic components. Several processes as endo-exocytosis, intracellular interaction with scaffold proteins and intersynaptic adhesion complexes have been suggested to tightly regulate the organisation of the local signal molecule population within the chemical synapse. Looking on the thermal agitation of transmembrane signalling molecules by surrounding lipid molecules visualises an amazing flexibility of their surface distribution and provoke the question: How precise or reliable can a single synapse signal be if all is in motion?

The consequent application of imaging techniques like fluorescent recovery after photobleach (FRAP) and single particle tracking in combination with cell biology experiments and electrophysiology has discovered a new relevant variable for neuronal communication, the stochastic molecular diffusion within the membrane. Despite the tightly packed molecular organisation of synapses, glutamatergic and gabaergic synapses need certain flexibility. Analysis of molecular mobility gives new aspects for time and space relation to molecular interactions influencing neuronal communication.

The presentations within the symposium will focus on different populations of molecules as AMPAR (O. Thoumine), GABAAR (S. Levi), Neurexins (Y. Fu), metabotropic receptors (M. Renner) and calcium channels (M. Heine), which are all involved in local signalling complexes and are key players in synaptic communication.

Symposium 21

Saturday, March 16, 2013
8:30 – 11:30, Lecture Hall 105

Chair: Martin Heine, Magdeburg

08:30 **Opening Remarks**

08:35 Olivier Thoumine, Bordeaux, France
ASSEMBLY OF FUNCTIONAL POST-SYNAPSES BY NEUREXIN-NEUROLIGIN ADHESIONS: ROLE OF LATERAL DIFFUSION (S21-1)

09:05 Sabine Lévi, Paris, France
MEMBRANE DYNAMICS OF THE K^+/CL^- CO-TRANSPORTER KCC2: A NOVEL, ACTIVITY-DEPENDENT MECHANISM OF NEURONAL CHLORIDE HOMEOSTASIS (S21-2)

09:35 Yu Fu, San Francisco, USA
FROM TRANSMISSION TO CONNECTION, A STUDY IN GABAGERIC SYNAPSE (S21-3)

10:05 **Coffee Break**

10:25 Marianne Renner, Paris, France
COMPETITION OF GLYCINE AND GABA RECEPTORS FOR SCAFFOLDING BINDING SITES AT SPINAL CORD INHIBITORY SYNAPSES (S21-4)

10:55 Martin Heine, Magdeburg
CALCIUM CHANNEL DYNAMIC IN THE NEURONAL MEMBRANE (S21-5)

11:25 **Concluding Remarks**

Introductory Remarks to Symposium 22

Insect motor control "From ion channels to learning, movement, and robotics"

Roland Strauss and Carsten Duch, Mainz

The production of motor behavior requires information flow from higher brain centers for initiation, decision making and planning via central pattern generating circuitry to the musculature. Various lateral, forward, and feedback interactions between different circuit levels and the muscular/skeletal system ensure reliable execution of movement as well as adaptive changes. A satisfactory understanding of motor circuitry requires analysis of the component neurons, their physiological properties, and their synaptic connections. However, understanding the resulting movements requires additional analysis of the biomechanical properties of the muscular and skeletal system. Finally, each level is subject to evolutionary, developmental and experience dependent changes. Consequently, research on motor control comprises multiple disciplines. This symposium attempts to bridge gaps between different levels of analysis by using insects as model organisms.

On the single neuron level S. Ryglewski (Tempe, USA) will show how RNA modifications produce multiple LVA and HVA calcium currents from one gene in *Drosophila* motoneurons and address resulting functions for courtship song and speciation. J.F. Evers (Cambridge, UK) will show that multiple good solutions exist for synaptic partner matching during the development of larval *Drosophila* motor circuitry. K. Hellekes, M. Gruhn and A. Büschges (Köln) address the motor flexibility in adult pattern generating networks during goal-directed behavior, and a related student talk by E. Berg (Köln) will analyze the roles of non-spiking interneurons in this context. Higher brain centers involved in decision making and motor learning will be addressed by T. Krause and R. Strauss (Mainz). They will show that plasticity improves oriented locomotion at different time scales ranging from the short-term integration of sensory information to life-long forms of learning. In a student talk J. Ache (Bielefeld) will analyze information transfer between mechanosensory brain and thoracic motor centers. Finally L. Theunissen and V. Dürr (Bielefeld) will use a large-scale database of natural movement sequences to analyze stick insect stepping patterns and derive predictions on neuronal control mechanisms and design principles for bio-inspired robotics.

Symposium 22

Saturday, March 16, 2013
8:30 – 11:30, Lecture Hall 9

Chair: Roland Strauss and Carsten Duch, Mainz

08:30 **Opening Remarks**

08:35 Stefanie Ryglewski, Tempe, USA and Mainz
FROM ION CHANNELS TO FUNCTION, BEHAVIOR, AND SPECIATION (S22-1)

09:00 Jan Felix Evers, Cambridge, UK
OPPORTUNE WIRING OF MOTOR CIRCUITS DURING DEVELOPMENT OF *DROSOPHILA* (S22-2)

09:25 Katja Hellekes, Matthias Gruhn, Ansgar Büschges, Köln
MOTOR FLEXIBILITY IN INSECT LOCOMOTION: CHANGING WALKING DIRECTION (S22-3)

09:50 **Coffee Break**

10:10 Eva Berg, Köln
SINGLE PERTURBATIONS CAUSE SUSTAINED CHANGES IN SEARCHING BEHAVIOR OF STICK INSECTS (S22-4)

10:25 Tammo Krause and Roland Strauss, Mainz
LEARNING IMPROVES COMPLEX MOTOR BEHAVIORS (S22-5)

10:50 Leslie Theunissen and Volker Dürr, Bielefeld
TWO CLASSES OF STEPS REVEALED BY THE NATURAL STATISTICS OF LOCOMOTION (S22-6)

11:15 Jan Marek Ache, Bielefeld
A NEURAL BASIS FOR SPATIAL COORDINATION OF LIMBS: DESCENDING INTERNEURONS IN THE STICK INSECT ANTENNAL MECHANOSENSORY SYSTEM (S22-7)

Introductory Remarks to Symposium 23

Purinergic signaling in sensory systems

Christian Lohr and Antje Grosche, Hamburg and Leipzig

In the past two decades, purinergic signaling has evolved into a major field of neuroscience and in particular of sensory information processing. Purinoceptors, which can be subdivided into adenosine-sensitive P1 receptors and ATP-sensitive P2 receptors, are highly expressed in sensory epithelia such as the retina and the olfactory epithelium, as well as in brain centers involved in analysis of sensory information. In this symposium, the latest advances in purinergic signaling research in the visual, olfactory and auditory systems are summarized. Antje Grosche and Lysann Wagner present data on retinal Müller cells, addressing a major issue concerning purinergic signaling, the significance of purinoceptors for glial cell physiology. Gary Housley investigates purinergic signaling in physiology, development, and degeneration of the cochlea. Daniela Hirnet and Natalie Rotermund demonstrate how purinoceptors are involved in neuron-glia-interactions as well as in the adjustment of network activity in the olfactory bulb, thereby contributing to odor information processing. Colleen Hegg studies the role of purinergic signaling for cell proliferation and hence regeneration of the olfactory epithelium, in which lifelong neurogenesis and replacement of degenerated sensory neurons takes place.

Symposium 23

Saturday, March 16, 2013
8:30 – 11:30, Lecture Hall 102

Chair: Christian Lohr and Antje Grosche, Hamburg and Leipzig

08:30 **Opening Remarks**

08:35 Antje Grosche, Leipzig
INFLUENCE OF PURINERGIC SIGNALING ONTO THE PHYSIOLOGY AND PATHOPHYSIOLOGY OF RETINAL (MÜLLER) GLIAL CELLS (S23-1)

09:00 Lysann Wagner, Leipzig
GLIOTRANSMITTER RELEASE FROM RETINAL MÜLLER GLIAL CELLS (S23-2)

09:15 Gary Housley, Sydney, Australia
PURINERGIC SIGNALING IN THE COCHLEA (S23-3)

09:50 **Coffee Break**

10:10 Daniela Hirnet, Hamburg
PURINERGIC SIGNALING IN THE OLFACTORY BULB (S23-4)

10:35 Natalie Rotermund, Hamburg
A_1 RECEPTOR-MEDIATED MODULATION OF NEURONAL NETWORK ACTIVITY IN THE OLFACTORY BULB (S23-5)

10:50 Colleen Hegg, East Lansing, USA
PURINERGIC SIGNALING IN THE OLFACTORY EPITHELIUM (S23-6)

11:25 **Concluding Remarks**

Introductory Remarks to Symposium 24

Practically profiting from the complexity of massively parallel electrophysiological data

Michael Denker and Sonja Grün, Jülich

Probing the organization of interactions within and across neuronal populations is an approach to uncover the principles of brain processing, driven by the rapidly advancing technical capabilities to record from hundreds of neurons in parallel. However, the complexity of these massive data streams and sophisticated behavioral paradigms calls for novel approaches and mathematical tools to exploit the parallel aspect of the data. Neuroinformatics is complementing these efforts by developing data models, storage concepts, and software tools tailored to meet these challenges.
This symposium brings together scientists who drive forward this line of research. Wilson Truccolo is a theoretical neuroscientist who investigates information coding by neuronal ensembles. His recent work has focused on relating the spike emission of single neurons to the temporal structure of population activity. Aimed at reconciling notions of synchrony on various scales of observation, Michael Denker links the relationship between the dynamics of precise synchronous activity of groups of neurons (cell assemblies) and rhythmic signals. Jozsef Csicsvari has pioneered the establishment of massively parallel recording techniques. He studies the role of assembly coding and oscillatory network dynamics in processes that govern the formation and retrieval of memory. Innovative approaches to study the patterns of population activity in the context of visual information coding are in the center of Hamutal Slovin's work. She analyzes the signatures of concerted network activity obtained by modern imaging technologies in behaving monkeys. Two young investigators, Iris Grothe and Stefan Schaffelhofer, present their current experimental work using multi-area recordings. The challenges of practically implementing data analysis protocols will be discussed by Andrew Davison. He is well-known for his numerous contributions in neuroinformatics that provide neuroscientists with advanced software tools, such as for provenance tracking. We encourage a discussion on how analysis approaches and neuroinformatics tools can be integrated into an efficient, synergistic and traceable workflow.

This symposium is supported by the German INCF Node (www.g-node.org).

Symposium 24

Saturday, March 16, 2013
8:30 – 11:30, Lecture Hall 8

Chair: Michael Denker and Sonja Grün, Jülich

08:30 **Opening Remarks**

08:35 Wilson Truccolo, Providence, USA
CHALLENGES IN THE STATISTICAL MODELING OF COLLECTIVE DYNAMICS IN NEURONAL ENSEMBLES (S24-1)

09:00 Michael Denker, Jülich
LINKING THE SPATIAL STRUCTURES OF PRECISE SPIKE SYNCHRONIZATION AND LOCAL FIELD POTENTIALS IN MOTOR CORTEX (S24-2)

09:25 Andrew Davison, Gif-sur-Yvette, France
PROVENANCE TRACKING FOR COMPLEX DATA ANALYSIS WORKFLOWS IN NEUROSCIENCE (S24-3)

09:50 Stefan Schaffelhofer, Göttingen
OBJECT OR GRIP TYPE REPRESENTATION? A COMPARATIVE POPULATION STUDY OF MACAQUE HAND GRASPING AREAS AIP, F5, AND M1 (S24-4)

10:05 **Coffee Break**

10:25 Jozsef Csicsvari, Klosterneuburg, Austria
IDENTIFICATION OF ASSOCIATED CELL ASSEMBLIES IN THE INTERCONNECTED BRAIN REGIONS OF THE HIPPOCAMPUS AND THE ENTORHINAL CORTEX (S24-5)

10:50 Iris Grothe, Frankfurt/Main
USING LARGE SCALE RECORDINGS IN IN PRIMATE VENTRAL VISUAL PATHWAY TO INVESTIGATE SIGNAL ROUTING BY INTER-AREAL GAMMA-BAND SYNCHRONIZATION (S24-6)

11:05 Hamutal Slovin, Ramat Gan, Israel
NEURONAL CORRELATES OF VISUAL PROCESSING AND PERCEPTION REVEALED BY VSDI IN BEHAVING MONKEYS (S24-7)