Introductory Remarks to Symposium 2

Optogenetics - tool development and application in neuroscience

Alexander Gottschalk, Frankfurt/Main

Optogenetic methods have opened a multitude of new possibilities for research in basic neuroscience, but also in understanding the neural and circuit basis of animal behavior, as well as of psychiatric disease, for example depression. Optogenetic methods further bear the potential for novel therapy of neurological and degenerative diseases. Optogenetic tools are light-sensitive proteins, adopted from nature, or engineered in the lab, which allow addressing different aspects of neuronal physiology, simply by application of light. Prominent optogenetic tools are microbial rhodopsins, which are used to induce depolarizing or hyperpolarizing membrane currents. Sophisticated regimes of expression of these tools in specific cell types *in vivo*, and illumination deep inside the brain, enable evoking complex patterns of activity, driving distinct behaviors, or modulating neuronal circuits. These tools can also be directed to intracellular membranes. Other optogenetic tools address enzymatic activities, e.g. generating or degrading second messengers, which can be linked to different cellular activities for two-component optogenetic control. The numerous and diverse applications of optogenetic tools sparked an interest in more functionalities to be rendered light-sensitive. Efforts to identify or generate novel optogenetic tools (and applications), including hardware for specific light delivery, are funded by the German Research Council (DFG) under the umbrella of the priority program SPP1926 (www.spp1926.org). In this symposium, members from the SPP1926 (Soojin Ryu, Silvia Rodriguez-Rozada, Benjamin Rost) are joined by Alexander Dieter, Yoon Seok Kim and Ofer Yizhar, to report on development of novel tools and their application in different model systems from cultured neurons, to flies, zebrafish and rodents. The tools and topics include: natural and engineered anion-conducting microbial rhodopsins and their structure, applied for neuronal silencing in cells and animals; Two-component optogenetics using light-activated adenylyl cyclases and cAMP-gated ion channels; Intracellular localization of engineered tools for organellar optogenetics; Exploring and affecting the stress response axis by optogenetics in zebrafish; Dissection of prefrontal circuits for cognitive control; Potential therapeutic applications for hearing restoration. We are looking forward to an exciting afternoon at the NWG Göttingen Meeting 2019!

Symposium 2

Wednesday, March 20, 2019
14:30 -16:30, Lecture Hall 9

Chair: Alexander Gottschalk, Frankfurt/Main

14:30 **Opening Remarks**

14:34 Yoon Seok Kim, Stanford, USA
STRUCTURAL MECHANISMS AND APPLICATIONS OF CHANNEL-TYPE OPTOGENETIC TOOLS (S2-1)

14:56 Silvia Rodriguez-Rozada, Hamburg
INTERROGATION OF NEURONAL CIRCUIT FUNCTION USING CUSTOMIZED OPTOGENETIC ACTUATORS AND SILENCERS (S2-2)

15:08 Benjamin Rost, Berlin
OPTOGENETIC TOOLS FOR NEUROSCIENCE BEYOND THE CLASSICAL APPLICATION OF MICROBIAL RHODOPSINS (S2-3)

15:30 Soojin Ryu, Mainz
OPTOGENETIC MANIPULATION OF THE STRESS RESPONSE IN LARVAL ZEBRAFISH (S2-4)

15:52 Alexander Dieter, Göttingen
NEAR PHYSIOLOGICAL SPECTRAL RESOLUTION AND DYNAMIC RANGE OF COCHLEAR OPTOGENETICS (S2-5)

16:04 Ofer Yizar, Rehovot, Israel
OPTOGENETIC DISSECTION OF PREFRONTAL CIRCUITS FOR COGNITIVE CONTROL (S2-6)

16:26 **Concluding Remarks**