Kolloquium des Instituts für Molekulare Physiologie

Montag, 15.01.18, 17:15 Uhr,

HS 18 (Johann-Joachim-Becher-Weg 7)

Prof. Dr. Peter Hegemann

Humboldt-Universität, Berlin

"Novel Photoreceptor Systems for Inhibitory Optogenetic Application"

During the past 12 years, neuroscientists employed light-activated ion channels as channelrhodopsins of the green alga Chlamydomonas to depolarize cells of interest and to fire action potentials in a sequence that precisely followed applied light trains, a technology named "Optogenetics". For cell inactivation mostly hyperpolarizing light-driven ion pumps were used although these pumps only transport a single ion per absorbed photon. Recently, we engineered a channelrhodopsin in such a way that it specifically conducts chloride (ChloC), which allows to clamp the membrane voltage to the chloride reversal potential. However, the chloride reversal potential greatly varies in different cell species and during development. We have tried to overcome this problem by two-component optogenetic approaches, (TCOs). As a proof of principle we combined a proton pump with proton sensitive ion channels such as ASIC2a to trigger with an initial pump current a larger Na^+-influx into the cell (TCO-ex), in expectation to replace later the ASIC by a K-conducting homologue (2). In parallel we employed the natural photo-activated adenylyl-cyclases bPAC and were able to activate cAMP-sensitive channels promoting Na^+ or Ca^{2+}-influx. In our most recent project we have characterized a rhodopsin-guanylyl-cyclase, RhGC, of the fungus *Blastocladiella emersonii*. This newly discovered member of the rhodopsin family bears a great potential for the activation of cGMP-activated channels (TCO-approach with internal coupling, TCO-in) and preferentially cNG-gated K-channel. Together with cGMP-, voltage- and Ca-reporters our new set of photoreceptors should open novel avenues for multicolor and multimodal activation and imaging in optogenetic experiments for a better understanding of brain function and cellular or evolutionary processes.