



TITLE : From a Phylogenetic Tree to Discovery of Inward H⁺ pump Xenorhodopsin and Alternative Optogenetic Approach

NAME: Valentin Gordeliy

E-mail: g.valentin@fz-juelich.de

Affiliation: ¹ Institute of Complex Systems (ICS), ICS-6: Structural Biochemistry, Research Centre Juelich, Juelich, Germany; ³ Institut de Biologie Structurale J.-P. Ebel, Université Grenoble Alpes-CEA-CNRS, Grenoble, France

We will describe discovery of inward membrane protein light-driven proton pumps. Inward plasma membrane native proton pumps have been unknown. Generation of electrochemical proton gradient is the first and universal step of cell bioenergetics provided by outward proton pumps. Therefore, the existence of inward was not expected. In our talk we describe comprehensive functional studies of the representatives of the yet non-characterized xenorhodopsins from *Nanohaloarchaea* family of microbial rhodopsins. We showed in experiments that they are inward proton pumps. We proved that in model membrane systems, *E.coli* cells, human embryonic kidney cells, neuroblastoma cells and rat hippocampal neuronal cells. We also solved the structure of a xenorhodopsin from *Nanosalina* (*NsXeR*) and suggest a mechanism of inward proton pumping. We demonstrated that the *NsXeR* is a powerful pump which is able to elicit action potentials in rat hippocampal neuronal cells up to their maximal intrinsic firing frequency, proving that the inwardly directed proton pumps are suitable for light induced remote control of neurons and are an alternative to the well-known cation selective channelrhodopsins.