

INTERNSHIP PROPOSAL

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Research project title: Viral rhodopsin type I.

5 Keywords to describe the project: Viral rhodopsins, membrane proteins, structural biology, protein functions, optogenetics.

Description of the project (aims, experimental techniques, recommended background):

Rhodopsins are the most universal and abundant biological light-energy transducers. They are found in all the domains of life (eukaryotes, bacteria and archaea) and also in viruses (Béjà and Lanyi 2014). Renaissance of rhodopsins research field became evident after the discovery that these proteins can be used in optogenetics. **Recently Yutin and Koonin (2012) reported that a distinct group of giant viruses infecting unicellular eukaryotes** that includes Organic Lake Phycodnaviruses (OLPV) and the Phaeocystis globosa virus (PGV) encode the predicted rhodopsins that had not been detected in viruses. Moreover, their search for metagenomic sequence data showed that putative viral proteorhodopsins are extremely abundant in marine environments. The predicted virus rhodopsins have low homology to the known rhodopsins. The function of viral rhodopsins is not clear and therefore it is also unclear how they influence the infected eukaryotes. Recently our group solved the first structure of an OLPV rhodopsin belonging to group II of virus rhodopsins. It opens the way to the understanding of the role of this unusual and amazing protein in virus infection, but the sequence of PGV rhodopsin belonging to group I of virus rhodopsins is very different from OLPV. **The goal of the proposed work is to characterize the function and structure of PGV viral rhodopsins. An additional aim of the project is to clarify at cell level the potential of this viral protein for optogenetic applications.**

Relevant publications of the team:

- 1) Gordeliy V., Labahn J., Moukhametzianov R., Efremov R., Granzin J., Schlesinger R., Büldt G., Savopol T., Scheidig A.J., Klare J. and M. Engelhard. Molecular basis of transmembrane signaling by sensory rhodopsin II– transducer complex. *Nature* (2002) 419, 484-487.
- 2) Moukhametzianov R.E., Klare J.P., Efremov R.G., Baeken C., Göppner A., Labahn J., Engelhard M., Büldt G. and V. Gordeliy Development of the signal in sensory rhodopsin and its transfer to the related transducer. *Nature* (2006) 440, 115-119.
- 3) Guschin I. *et al.* and V. Gordeliy (2015) Crystal structure of a light-driven sodium pump. *Nat. Struct. Mol. Biol.* **22**, 390–395