Universität Münster

PLANT BIOLOGY COLLOQUIUM

Winter Semester 2026/2027

Time: 12:30 p.m.

Place: Lecture Hall Schlossplatz 4

Date: Tuesday, 03.11.2026

Speaker: Prof. Dr. Peter Hegemann
Humboldt Universität zu Berlin
Institute of Biology, Experimental Biophysics
(Host AG Hippler)

Abstract

SEEING RED is not always bad

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When one consults AI about what "Seeing Red" means one might get the answer: “It is an idiom for experiencing sudden, intense rage, often associated with a temporary loss of temper”. This might be related to what we experienced when we first reported about the far-red sensitive Rhodopsin NeoR discovered in Chytridiomycota fungi where it functions as one monomer of heterodimeric Rhodopsin-Guanylyl-Cyclases. The NeoR absorption peaks around 700 nm, the spectrum is narrow, the extinction coefficient is around 130000 M^{-1} cm^{-1}, and the protein is highly fluorescent. These properties are quite in conflict with everything we knew about rhodopsins before [1]. Several groups including leading theoreticians speculated about the molecular origin of these properties, but the biological meaning of NeoRs and red light sensing in fungi is still unclear today. Second, Bestrhodopsins from marine algae, with a single rhodopsin or two rhodopsins in tandem that are linked to bestrophin ion channel units, are also mysterious in many respects due to the formation of large homopentameric light-gated ion channels, yet also absorb far red light that might peak up to 675 nm, which again goes far beyond any classic microbial or animal rhodopsin absorption [2] (Misra et al. unpublished). Third, we have recently studied 17 visual rhodopsins (out of more than thirty) of Mantis Shrimp *Neogonodactylus oerstedii* and show that 2 absorb mainly blue light, 12 absorb mostly green light and 3 absorb red light with maximal sensitivities beyond 600 nm. Despite the multi colour sensitivity of their highly complex eyes, this discovery was unexpected because in previous microspectrophotometric studies on intact eyes only rhodopsins with maximal sensitivities ranging from 330 to 550 nm were recorded. It has been suggested that red and far-red vision in Mantis Shrimp is generated by filter pigments of Row 2 and 3 of the central layer of the eyes, narrowing the spectral range but also drastically reducing the overall sensitivity of the ommatidium [3]. I will discuss and contrast the very special properties of these red and far-red rhodopsins, and speculate about their functions in algae, fungi and Mantis Shrimp.

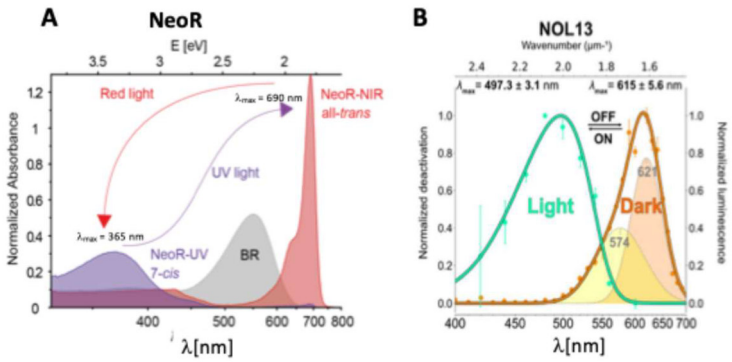


Figure 1 Spectral properties of red- and far-red sensitive rhodopsins. A: NeoR from the fungus *Rhizoclosmatium globosum* with far-red absorbing dark state and UV-absorbing light-state. Bacteriorhodopsin (BR) absorption is shown for comparison **B**: NOL13 rhodopsin from the Mantis Shrimp *Neogonodactylus oerstedii* with red absorbing dark state and blue/green absorbing light-state.

References

[1] W. Busse et al. *EMBO J*, (2025) doi.org/10.1038/s44318-025-00452-x

[2] A. Rozenberg et al. *Nature Structural Biology* (2022) 29, 592.

[3] C. Brouillon, *bioRxiv,* (2025) *Science Advances* 12, eaef5666.