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Light-induced Helix Movements in Channelrhodopsin-2

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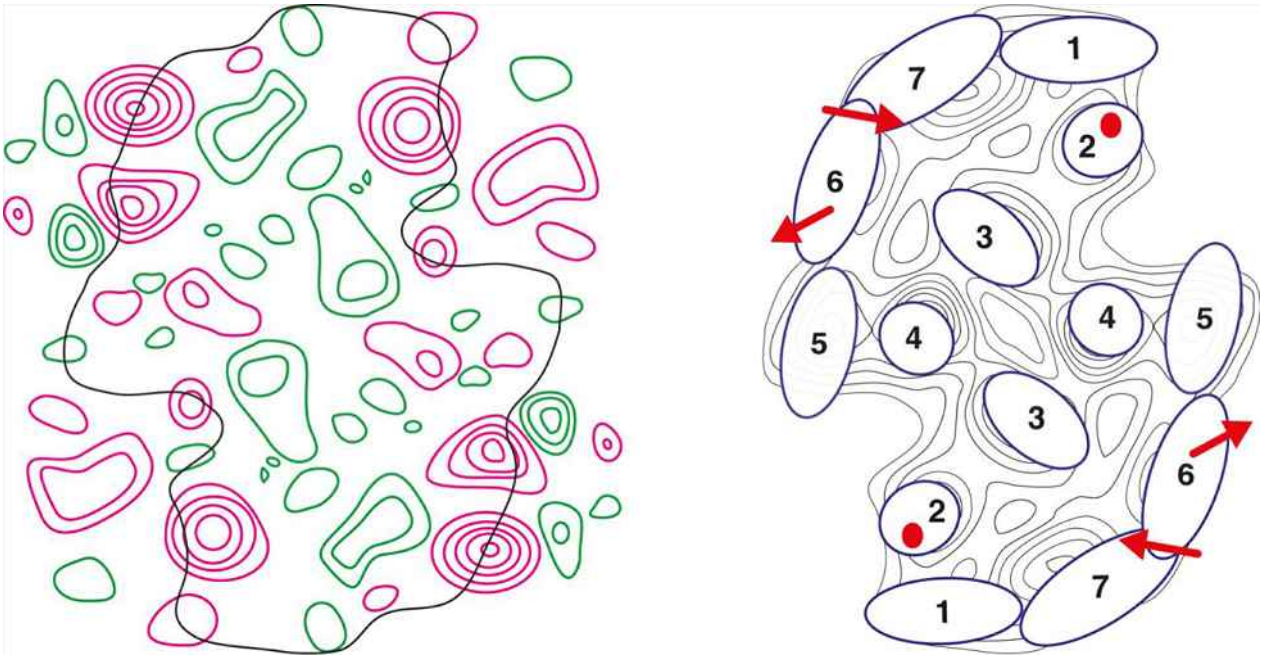
Electron crystallography has the unique advantage of visualizing membrane proteins in a native-like lipid environment, which likely favors the native conformation. In addition, it allows for the protein to undergo conformational changes in response to their activating signals. We used 2D crystals of channelrhodopsin-2, a cation-selective light-gated channel from Chlamydomonas reinhardtii (Nagel et al., 2003) to study light-induced conformational changes of this intriguing channel, which is currently a powerful tool in optogenetics. Therefore, 2D crystals of the slow photocycling C128T ChR2 mutant were exposed to 473 nm light and rapidly frozen to trap the open state. Projection difference maps at 6 Å resolution show the location, extent and direction of light-induced conformational changes in ChR2 during the transition from the closed state to the ion-conducting open state. Difference peaks indicate that transmembrane helices (TMHs) 2, 6, and 7 reorient or rearrange during the photocycle. No major differences were found near TMH3 and 4 at the dimer interface. While conformational changes in TMH6 and 7 are known from other microbial-type rhodopsins, our results indicate that TMH2 has a key role in light-induced channel opening and closing in ChR2.

[1] *Nagel G et al., 2003; P Natl Acad Sci Usa 100: 13940–13945*



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