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Protonation Dynamics
in Protein Function

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Freie Universität Berlin

via WebEx

➤ Colloquium

➤ Professor Hideaki Kato

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Structural basis for channel conduction in the pump-like channelrhodopsin ChRmine

ChRmine, a recently discovered pump-like cation-conducting channelrhodopsin, exhibits puzzling properties (large photocurrents, red-shifted spectrum, and extreme light-sensitivity) that have created new opportunities in optogenetics. ChRmine and its homologs function as ion channels, but by primary sequence more closely resemble ion-pumping rhodopsins; mechanisms for passive channel conduction in this family have remained mysterious. In this talk, I will present the 2.0-Å resolution cryo-EM structure of ChRmine, revealing architectural features never seen before in channelrhodopsins: trimeric assembly, a short transmembrane-helix 3, a twisting extracellular-loop 1, large vestibules within the monomer, and an unprecedented opening at the trimer interface. We applied this structure to design three proteins (rsChRmine, hsChRmine, and frChRmine) suitable for fundamental neuroscience opportunities. These results illuminate conduction and gating of pump-like channelrhodopsins and point the way toward further structure-guided creation of novel channelrhodopsins for applications across biology.

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