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Poster Abstract

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Nanodiscs as a novel approach to resolve inter-protein energy transfer within the photosynthetic membrane of purple bacteria

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Photosynthetic purple bacteria capture sunlight and convert it to chemical energy with almost 100% quantum efficiency: almost every photon absorbed leads to charge separation. Such high efficiency is achieved through a series of ultrafast inter-protein energy transfer events within an antenna network of light-harvesting proteins located in the photosynthetic membrane. Understanding how the organization of proteins within the membrane leads to efficient energy transfer is imperative to designing efficient artificial solar harvesting techniques. Determining inter-protein energy transfer between light-harvesting complex 2 (LH2) proteins, the most common light-harvesting protein *in vivo*, has proven challenging due to the heterogeneous organization of proteins within the membrane environment. In this work, we introduce model membrane nanodiscs as a novel technique to reconstruct the complex membrane environment in a controlled manner. By forming nanodiscs large enough to incorporate two variants of LH2, we can directly resolve inter-protein energy transfer. By controlling nanodisc size, we can change the inter-protein distance and resolve the effect of membrane organization on energy transfer rate. Using a combination of ultrafast transient absorption spectroscopy, cryogenic electron microscopy, and quantum chemical calculations, we find that LH2 complexes prefer to associate closely in the membrane (25 Å), with an energy transfer rate of 5.7 ps. The results suggest that these tightly-packed LH2s are important for long-distance energy transfer, as the 25 Å distance is similar to the most common inter-protein distance *in vivo*. Overall, our work introduces nanodiscs as a platform to study complex energy transfer events and the effect of membrane organization on critical biological processes.