Orderphilic effects of model membrane proteins and its shape dependency

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Transmembrane proteins mediate many essential biochemical processes such as signal transduction, intercellular communication, transporting molecules and enzymatic reactions. Transmembrane proteins often form membrane subdomains with other components like glycolipids and cholesterols, which is well known as raft hypothesis. These membrane subdomains play crucial roles in biochemical functions. Despite of the biological importance, the physical origin of lipid raft remains elusive. We find that transmembrane proteins could induce a local ordered phase of lipids when the length of hydrophobic region of transmembrane proteins fits well with that of the ordered phase of lipids. We refer to these effects as the orderphilic effect. We also find that beside the length of hydrophobic region of transmembrane proteins, the orderphilic effets depend on the structure of transmembrane proteins. When the cross sectional structure of a model membrane protein is commensurate to the hexagonal structure of the ordered phase of membranes, the orderphilic effects appears more strongly. On the other hand, when the cross sectional structure of model membrane protein is not commensurate to the local structure of lipids, the orderphilic effects become weak. In this work, we quantify the strength of orderphilic effects of model transmembrane proteins.