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Adsorption of Lipid Bilayers to Monolayers: A New Triple Layer System for Studying Membrane Proteins

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Lipid monolayers can be used as very simple model system for one membrane leaflet. They have the advantages of being perfectly oriented, completely hydrated, and accessible through the aqueous phase. Thus, they are well suited for interaction studies with membrane binding compound, such as proteins or peptides. A variety of methods can be used in these studies, e.g., film balance measurements, fluorescence microscopy, infrared reflection-absorption spectroscopy (IRRAS) as well as X-ray reflectometry or scattering. However, no membrane spanning molecules can be studied in this system until now. Therefore, we are aiming to design a new membrane model system that makes the many advantages of established monolayer methods accessible for more complex samples.
We are exploring methods to assemble lipid bilayers underneath lipid monolayers at the air water interface. These bilayers shall host membrane spanning molecules such as integral membrane proteins or other pore forming molecules. The bilayers will be oriented, allowing to deduce molecular orientations from experiments, while still being in a well-hydrated and natural environment. We will present successful attempts in constructing such a model system, i.e., the adsorption of different lipid nanodiscs or vesicles to lipid monolayer at the air-water interface. Two different strategies, i.e., protein mediated adsorption and electrostatic adsorption lead to stable and oriented adsorption of polymer stabilized nanodiscs to the monolayer. We will show that these model systems combine the advantages of several well-established membrane models discuss further perspectives and applications.