**IMPRS on Multiscale Biosystems**

**Title:** Light-Driven Control of Interaction Strength/Potential of Colloids  
**PI:** Prof. Peter Saalfrank (UP, Theory) and Prof. Svetlana Santer (UP, Experiment)  
**In collaboration with:** -

**Project description:** Recently, the phenomenon of diffusioosmosis has been demonstrated to be a versatile and powerful means to generate local hydrodynamic flows at solid liquid interfaces when exploited with photosensitive surfactants bearing an azobenzene subunit (see Figure 1a). The flows are driven by pressure gradients that originate from spatial gradients in the concentration of the surfactants trans- and cis species. When certain types of porous particles are immersed into azobenzene containing surfactant solution, the colloids are dressed by a local convective flow that leads to an effective repulsion between them (Figure 1b). These dressed particles are a promising starting point for creating different types of active colloids with tunable mutual interactions or self-propulsion.

![Figure 1](image)

**Figure 1.** (a) An example of the chemical structure of an azobenzene containing cationic surfactant. Shown below is a scheme of the photo-isomerization of the azobenzene group. (b) Scheme of the formation of local light driven diffusioosmotic flow around single porous particle.

However, the tuning of the processes described requires to understand the kinetics of photo-isomerization under various illumination conditions, and to characterize isomerization (photo-and thermally induced) under non-standard conditions, such as in confined geometries and within small aggregates of photosensitive surfactants (micelles). This project is thus planned as a close collaboration of the laboratories of Prof. Saalfrank, where the student will carry out quantum chemical calculations on the kinetics and dynamics of single surfactant molecules employing transition state theory, non-adiabatic surface hopping dynamics and mixed quantum mechanical-molecular mechanical (QM/MM) simulations, and corresponding experiments in the experimental group of Prof. Santer, where suitable model systems will be designed, fabricated and studied systematically with optical and atomic force microscopy, Zeta Potential measurements, and UV-absorption spectrometry.

**Required background:** may be one or a mixture of theoretical physics, physical chemistry, optics, polymer physics.
Paper to read before the interview:


Contact: Prof. Peter Saalfrank and Prof. Svetlana Santer, e-mail: santer@uni-potsdam.de