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Physikalischen Kolloquium
Montag, 03.07.2017
16:15 Uhr in N24/H13

Dr. Erika Eiser
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Optical trapping of colloids at a liquid-liquid interface

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Optical tweezing is an established tool to examine interactions at the micro and nanometer level. Such forces are typically assessed by using an optically trapped particle as a probe. Since the size of an optical trap is usually of the same order of magnitude of the bead diameter, multiple particles can enter the same trap. This results in multiple scattering between the particles themselves, which display the tendency to reversibly form ordered structures: the phenomenon is dubbed optical binding [1]. The ordered structures are either chains of particles along the propagation axis or two dimensional crystalline patterns perpendicular to the laser beam [2]. The latter, referred to as lateral optical binding, is of particular interest as the creation of ordered, quasi-2D patterns of many distinct colloids or nano-particles is one of the key challenges in complex selfassembly. Complex cluster formation is however hindered by the scattering optical force along the beam propagation direction often destroying the crystal. Implementation of either complex or multiple beam trapping setups or the use of solid surface as a support for the crystal have been adopted to counteract the scattering force [3], but these approaches limits the study of extended clusters held together solely by optical forces. In this talk, we will show that a liquid-liquid interface can be successfully employed to study lateral optical binding of colloids in a single-beam configuration. Here, we graft the colloids to an oil-water interface by using DNA tethers, as illustrated in our recent DNAfunctionalized oil droplet (OD) model system [4]. The tether provides full mobility to the colloids on the lateral plane while balancing the optical scattering force along the beam propagation direction, effectively confining their motion to a quasi-2D plane. Extended colloidal clusters can thus form under the action of a single-beam optical trap, where inter-particle interactions are only mediated by light and excluded volume effects. After a brief introduction of our emulsion model system, we report qualitative observation of lateral optical binding of colloidal particles grafted to the ODs. Then, we show how the obtained close-packing structures can be strengthened or relaxed upon adding additional inter-particle interactions. Finally, we report potential energy measurements and trap stiffness estimations of a single trapped particle at the liquid-liquid interface by tuning the light intensity and trap position. This clarifies under which assumptions the liquid-liquid interface under study can be considered “clean” and quasi-ideal 2D motion of the colloids is achieved. We conclude by stressing how the novelty of our system allows for interparticle interactions only mediated by light and opens a new route toward the study and the realisation of extended photonic clusters.

[1] R. W. Bowman, and M. J. Padgett, Reports on Progress in Physics 76, 2 (2013).
[2] K. Dholakia, and P. Zemanek, Reviews of Modern Physics 82, 2 (2010).
[3] M-T. Wei, J. Ng, C. T. Chan, H. D. Ou-Yang, Scientific Reports 6, 38883 (2016).
[4] D. Joshi, D. Bargteil, A. Caciagli, J. Burelbach, Z. Xing, A. S. Nunes, D. E. P. Pinto, N. A. M. Araujo, J. Bruijc, E. Eiser, Science Advances 2, 8 (2016).

Ab 16.00 Uhr Kaffee, Tee und Kekse vor dem Hörsaal H13
Organisation: **Prof. Dr. F. Jelezko, Tel. 23750**
Host: **Prof. Dr. O. Marti, Tel. 23011, off.: 23010**