Seminar

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Cosmology in a petri dish? Simulation of collective dynamics of colloids at fluid interfaces

Interfacially trapped, micrometer-sized colloidal particles interact via long-ranged capillary attraction which is analogous to two-dimensional screened Newtonian gravity with the capillary length *l* as the tuneable screening length. Using Brownian dynamics simulations, density functional theory, and analytical perturbation theory, we study the dynamics of an initially prepared distribution of colloids, either a random homogeneous distribution, or a finitely-sized patch of colloids. Whereas the limit $l \to \infty$ corresponds to the global collapse of a self-gravitating fluid, for smaller *l* the dynamics crosses over to spinodal decomposition showing a coarsening of regions of enhanced density which emerge from initial fluctuations [1,2]. For the finite patch of colloids and intermediate *l* we predict theoretically and observe in simulations a ringlike density peak at the outer rim of the disclike patch, moving as an inbound shock wave [1]. Experimental realizations of this crossover scenario appear to be well possible for colloids trapped at water interfaces and having a radius of around 10 micrometer [3]. Finally, the influence of hydrodynamic interactions on this capillary collapse will be discussed.

[1] J. Bleibel, A. Dominguez, S. Dietrich, and M.Oettel, Phys. Rev. Lett. 107, 128302 (2011)
[2] J. Bleibel, A. Dominguez, M. Oettel, and S. Dietrich, Eur. Phys. J. E 34,125 (2011)
[3] A. Dominguez, M. Oettel, and S. Dietrich, Phys. Rev. E 82, 011402 (2010).

Wednesday, January 18, 14h15

Hörsaal Makromolekulare Chemie, Stefan-Meier-Str. 31

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