INTERDISCIPLINARY CENTRE FOR ADVANCED MATERIALS SIMULATION

Monday, 18th of April, 4:30 p.m.
ICAMS Seminar room UHW 11/1102

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Optical tweezers, from Brownian motions in shear flow to the adhesion of red blood cells

We use optical tweezers both to study fluctuations in hydrodynamic systems and cell-cell adhesion in biological systems. For the first case, shear-induced cross-correlations of particle fluctuations perpendicular and along stream-lines are investigated experimentally and theoretically. Direct measurements of the Brownian motion of micron-sized beads, held by optical tweezers in a shear-flow cell, show a strong time-asymmetry in the cross-correlation, which is caused by the non-normal amplification of fluctuations. Complementary measurements on the single particle probability distribution substantiate this behavior and both results are consistent with a Langevin model. In addition, a shear-induced anti-correlation between orthogonal random-displacements of two trapped and hydrodynamically interacting particles is detected, having one or two extrema in time, depending on the positions of the particles.

For the second system we use holographical optical tweezers to investigate the role of red blood cells in thrombus formation. Red blood cells were suspended in a buffer solution and an irreversible cell-cell adhesion could be induced by the addition of the lysophosphatidic acid (LPA). LPA is released as a second messenger by activated platelets. Both substances lead to an influx of Ca2+ and eflux of K- followed by the activation of lipid scramblase Ca2+ leading to an exposure of phosphatidylserine on the outer leaflet. The adhesion forces could be determined to be larger than 25 pN and thus larger than any hydrodynamic forces in physiological blood flow that could eventually break up the formed aggregates.