Internship / Thesis

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Random Motility near Soft Interfaces

Motility of microscopic biological entities with the aim of reaching specific targets is a central question of biophysics, as evidenced by: cancer metastasis, durotaxis of stem cells, antibody recognition, or DNA replication, among numerous other examples. In an idealization attempt, this problem might be reduced to simple mechanics through a combination of essential ingredients: viscous flow, elastic boundaries, confined environment, charges and fluctuations. In echo to this point, a key problem of modern nanoscience amounts to understanding how to build the missing links between the antinomic molecular and continuum descriptions of matter or, stated differently, between the bottom-up and top-bottom approaches of condensed matter. Therefore, once again, combining continuum ingredients such as hydrodynamics and elasticity, together with molecular fluctuations at small scales, emerges as a crucial task. Right from the above arguments, the study of Brownian motion in soft-lubricated environments appears as one of the canonical problems of biophysics and nanophysics. Despite the obvious character of this statement, it is intriguing to notice that experimental studies are inexistent. The present project thus naturally aims at filling this gap. Our strategy is to develop atomic-force-microscopy (AFM) experiments at equilibrium, with attached thermally-driven micrometric colloidal probes evolving near various soft substrates, in order to reveal the fundamental coupling between random motility and the softness of neighboring boundaries. The team has developed complementary experimental approaches as well as theoretical methods that will be highly beneficial to the project.