Long-range interfacial repulsion across aqueous solutions of high ionic strength

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Since colloidal dispersions have a significant importance in our daily life, it is of special interest to get a deeper understanding of which interfacial forces govern their stability and how this stability can be tailored.
For aqueous electrolyte solutions, DLVO theory is a powerful and well-established framework to describe these interactions at low and intermediate ionic strengths. In contrast, the situation at high ionic strength is less understood, and the main methods for direct force measurements give inconsistent results. Whilst the surface force apparatus (SFA) provides clear evidence for a re-entrant behaviour of the repulsion in the highly concentrated regime (termed underscreening) for a wide range of different electrolytes [1], similar observations were not possible with the atomic force microscope (AFM) [2]. In this presentation, we will examine the reasons for these fundamental differences. We will show that approaching the experimental conditions of AFM measurements towards the ones of SFA could lead to similar results with both methods [3]. Specifically, in an attempt to explore experimental screening lengths across a wide suite of electrolyte concentrations, we demonstrate the experimental parameters dominating the occurrence of long-range repulsion: long equilibration times, large contact areas and slow approach velocities. We will discuss the reasons for the controversially discussed phenomenon of long-range repulsion at high ionic strengths.

Keywords:
Interfacial forces, Colloidal Probe AFM, long-range electrostatic repulsion, underscreening

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