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Kinetics of particles with short-range interactions

Abstract

Particles in soft-matter systems (such as colloids) tend to have very short-range interactions, so traditional theories, that assume the energy landscape is smooth enough, will struggle to capture their dynamics. We propose a new framework to look at such particles, based on taking the limit as the range of the interaction goes to zero. In this limit, the energy landscape is a set of geometrical manifolds plus a single control parameter, while the dynamics on top of the manifolds are given by a hierarchy of Fokker-Planck equations coupled by "sticky" boundary conditions. We show how to compute dynamical quantities such as transition rates between clusters of hard spheres, and then show this agrees quantitatively with experiments on colloids. This framework can be used to investigate the landscape and kinetics of particles with specific, designed interactions, so if time permits we comment on applications to questions of self-assembly.