Anomalous transport and dynamic phase transitions in stochastic clustering under confinement

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When a system of interacting particles is driven out of equilibrium macroscopic long range correlations emerge even if the interactions are local. We study the stochastic dynamics of particles driven out of equilibrium by an external force and moving in a dense quiescent bath through narrow channels. As the number of these intruders hincreases, a transition from a mixed phase to a collective pattern of dense clusters and dilute phases sets in. Clustering is mediated by the interaction with the bath and follows from a stochastic aggregation-fragmentation process. We show that the phase separation persists as confinement stabilises the thermal fluctuations, leading to large and long lived clusters that facilitate the formation of clogs. When the clogs are formed the intruders exhibits a dynamic phase transition from superdiffusion to single-file and entrain the whole system into an anomalous slow dynamics. As a result, dynamics exhibit negative differential mobility.