

CLUSTERING FOR INTERACTING PARTICLE SYSTEMS WITH SHORT RANGE ATTRACTIVE POTENTIALS

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We consider the dynamics of a system of weakly interacting diffusions, interacting via a short range/localized attractive potential in a box. We prove that such an interaction potential leads to a discontinuous phase transition in the mean field limit. This dynamics exhibits dynamical metastability that leads to cluster formation and the breakdown of the validity of the mean field approximation. Furthermore, we show that, in an appropriate scaling limit, the particle dynamics converges to a system of coalescing Brownian motions, described by the massive Arratia flow. We present detailed numerical experiments both for the overdamped as well as the underdamped Langevin dynamics in the weak friction limit.