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Mean-field equations and metastability for stochastic particle systems

The derivation of effective single-particle dynamics from interacting many-particle systems has a long history in the context of kinetic theory. While effective dynamics are often used as a starting point to study stochastic lattice gases in the theoretical physics literature, their rigorous derivation in this context has attracted attention only recently. We focus on the dynamics of cluster aggregation driven by monomer exchange, for which we derive effective rate equations in a mean-field scaling limit from an underlying particle system. We establish the propagation of chaos under generic growth conditions on particle jump rates, and the limit provides a Master equation for the single-site dynamics of the particle system, which is a non-linear birth-death chain. Conservation of mass leads to non-uniqueness of stationary measures and a non-trivial ergodic behaviour, which can also involve metastable states and coarsening for condensing particle systems. This is joint work with Watthanan Jatuviriyapornchai and Andre Schlichting.