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Periodic homogenisation and the mean field limit for weakly interacting diffusions

We analyse the statistical behavior of a large number of weakly interacting diffusion processes with highly oscillatory periodic interaction potentials. We study the combined limit of taking the number of particles to infinity, also known as the mean field limit, and taking the period of the potential to zero, also known as the homogenisation limit. In particular, we show that these limits do not commute if the quotiented process undergoes a phase transition, that is to say if it admits more than one invariant measure. As an incidental, we analyze the energetic consequences of the classical fluctuation central limit theorem and derive optimal rates of convergence of the Gibbs measure to the unique limit of the mean field energy in relative entropy. Joint work with Matias Delgadino and Greg Pavliotis.