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*Entropy and the Kac master equation*

**Abstract**

The Kac master equation models the behavior of a large number of randomly colliding particles. Due to its simplicity it allows, without too much pain, to investigate a number of issues. E.g., Mark Kac, who invented this model in 1956, used it to give a simple derivation of the spatially inhomogeneous Boltzmann equation.  One important issue is the rate of approach to equilibrium, which can be analyzed in various ways, using, e.g., the gap or the entropy. In these lectures,
I will introduce the model, discuss various classical issues such as propagation of chaos, the gap and then move on to the main topic on entropy production and decay estimates of the entropy.  Some of the newer results will require tools from mathematical physics such as correlation inequalities on the sphere, the geometric version of the Brascamp Lieb inequalities and Nelson's hyper-contractive estimate. I explain these results and give some of the proofs.