Rapid mixing in dissipative many-body quantum systems

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The evolution of non-isolated quantum systems which interact weakly with an environment can be described by a semigroup of trace-preserving completely positive maps, an approach known as Markovian approximation. In this talk I will consider the case of many quantum particles arranged on a lattice, when the evolution converges to a unique steady state. A very natural quantity to study in this setting is the so-called mixing time, i.e. the time it takes for any initial state to reach a neighborhood of the fixed point. In particular, I will discuss the scaling of the mixing time as a function of the number of particles. If the mixing time scales sub-linearly, we will call the evolution rapidly mixing.

I will show that in the rapid mixing regime a number of very interesting properties of the system can be obtained. First of all, the evolution is stable, in the appropriate sense, under weak but extensive perturbations. Secondarily, the unique fixed point of the evolution has only short-ranged correlations, and it satisfies an area law for the mutual information. I will also comment on how the spectrum of the generator of the evolution does not contain enough information to determine whether a given system is rapidly mixing, and how one can use a quantum version of the log-Sobolev inequality to show it instead.