Quantum (thermo-)dynamics of randomly probed systems

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We study the dynamics of open quantum systems subjected to random repeated probing by external degrees of freedom in the framework of coarse-grained monitoring master equations. They capture the system's dynamics in the natural regime where interactions with different probes do not overlap, but are otherwise valid for arbitrary values of the interaction strength and mean interaction time. The framework can be used to study equilibration and energy exchange with thermal or non-thermal reservoirs, or to model processes driven by random measurements and feedback operations.

For example, collisional channels with identical probes prepared in Gibbs states have been used to describe thermalisation: while this is the case for many choices of parameters, for others one finds out-of-equilibrium states including inverted Gibbs and maximally mixed states. Gapless probes can be interpreted as pointers performing an indirect measurement, which may require an external work supply to mediate the interaction.

We show how random measurement-feedback channels can be employed to construct continuous, self-contained models of measurement-driven engines without the notion of a predefined engine cycle. On a separate note, we show how to use these channels to describe Newtonian gravity as a fundamentally classical interaction.