Collisional Reservoirs and Thermalization

Jorge Tabanera Bravo[1] and Juan M.R. Parrondo[1],
[1] Departamento de Estructura de la Materia, Fsica Termica y Electronica and GISC,
Universidad Complutense de Madrid, 28040 Madrid, Spain

Collisional reservoirs are becoming a remarkable tool in the field of Open Quantum Systems due to their capacity to simulate thermal interactions in a relatively simple way. The more common implementation of these reservoirs consists on a repeated interaction of the target quantum system, S, with identical copies of ancillary systems called units, U. These units are refreshed into a thermal state after each interaction, mimicking the action of the thermal bath. However, the continuous switching on and off of the interaction between the system and the units provides additional energy to the system. This external work prevents thermalization in certain cases [1], yielding spurious currents and the violation of the second law.

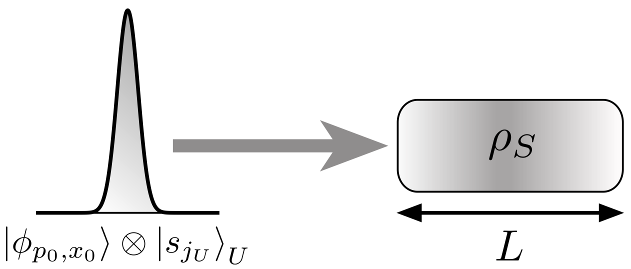

Fig. 1. Sketch of the autonomous system. The units U possess an additional kinetic degree of freedom, p, whose state is a wave packet with a random momentum distribution according to the effusion distribution. The system acts as a scatterer of the wave packets. [5]

This situation is treated in a serie of works [2, 3, 4]. There is shown how the introduction of the kinetic degree of freedom of the units, p, makes the whole setup autonomous. The unit state is then a narrow wave packet with random momentum, Fig.1. In this case, the energy to switch on and off the interaction is provided by the spatial degree of freedom of the unit. If the momentum is in equilibrium, the energy exchange is no longer work, but heat, and the system thermalizes [2, 3]. As a result, this approach captures all the essential features of a genuine thermostat.

In [5] we extend previous results by solving the complete scattering problem, and find approximations to the exact scattering map preserving microreversibility at high temperatures. The usual repeated interaction mechanism can be recovered from this solution as a high temperature limit, Fig.2.

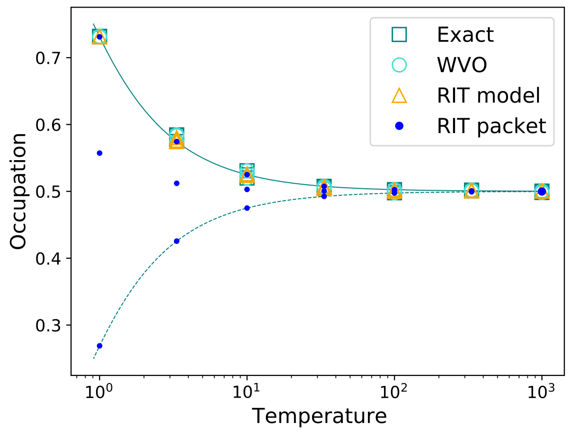

Fig. 2. Comparison between the implementation proposed in [5] (WVO) and the usual repeated interaction mechanism (RIT).

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