

# Macroscopic irreversibility in a quantum extension of the Kac ring model and beyond

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## **Abstract**

As well known since the times of Boltzmann, irreversible behavior on the macroscopic scale does not contradict the reversibility of microscopic equations of motion. The key lies in the typicality of the macroscopic motion, which is a consequence of a huge separation between the microscopic and the macroscopic scales. A simple classical model where the emergence of the macroscopic dynamics can be rigorously analysed was introduced by Mark Kac in 1950's.

In the talk I will discuss an extension of the Kac model to a unitary dynamics of quantum spins. In this model the magnetization vector satisfies an autonomous equation for a class of initial data and exhibits the relaxation to equilibrium. Moreover, the Gibbs–von Neumann entropy is proven to be a non-decreasing function of time ( $H$ -theorem). The link between macroscopic autonomy and  $H$ -theorem will be discussed in general within both classical and quantum formalisms, and sufficient conditions under which a process satisfies an  $H$ -theorem will be provided.

*Joint work with W. De Rock, Tim Jacobs, and C. Maes.*