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The Non Equilibrium Thermodynamics of Piecewise Deterministic Markov Processes

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A Piecewise Deterministic Markov Process is a stochastic process whose state space is parameterized by a continuous variable and a discrete variable, called mechanical and chemical state respectively. The mechanical state evolves according to a system of first order differential equations depending on the chemical state, while the chemical state evolves according to a stochastic jump dynamics whose transition rates depend on the mechanical state. In the limit of high frequency of the chemical jumps, we prove an Averaging Principle and a corresponding Large Deviation Principle for the mechanical evolution and the chemical occupation measure. We discuss stationarity and time reversal symmetries for this class of models. In a non-Markovian framework we recover a fluctuation-dissipation relation among the large deviation rate functionals, firstly discussed by Bertini, De Sole, Gabrielli, Jona-Lasinio and Landim in the framework of stochastic interacting particle systems. All the results are illustrated by explicit computations.

This is joint work with Alessandra Faggionato and Marco Ribezzi Crivellari.