DY 34: Invited Talk

Time: Wednesday 9:30–10:00 Location: ZEU 160

Invited Talk DY 34.1 Wed 9:30 ZEU 160

Brownian systems with time-delay: non-equilibrium thermodynamics and connection to active systems — •Sabine H.L. Klapp and Sarah A.M. Loos — Institut für Theoretische Physik, TU Berlin, Hardenbergstrasse 36, 10623 Berlin, Germany

Recently, the dynamics of stochastic systems involving time-delay has become a focus of growing interest. Time delay may originate, e.g., from a feedback control protocol, but it is also inherent in many living and active systems. The corresponding theoretical description is challenging due to the non-Markovian nature of the underlying Langevin equations [1]. Here we discuss such systems in terms of stochastic thermodynamics. Considering first a colloidal particle in a double-well potential and a time-delayed trap, we provide a novel analytical expression and numerical results for the heat production [2]. We then discuss systems with discrete and distributed delay, describing them by coupled Markovian equations involving n auxiliary variables with linear, yet *non-reciprocal* coupling [3]. We provide arguments that non-reciprocity inevitably leads to non-equilibrium as reflected by a broken fluctuation-dissipation theorem and nonzero entropy production. We also discuss connections to active systems, particularly the active Ornstein-Uhlenbeck model involving coloured noise.

[1] S. A. M. Loos and S. H. L. Klapp, Phys. Rev. E **96**, 012106 (2017); J. Stat. Phys. **77**, 95 (2019)
[2] S. A. M. Loos and S. H. L. Klapp, Sci. Rep. **9**, 2491 (2019)
[3] S. A. M. Loos, S. M. Hermann, S. H. L. Klapp, arXiv 1910.08372.