Dimensionality in sample-path statistical mechanics: $d = 1$ really is the loneliest number

Cai Dieball and Aljaž Godec*
Mathematical bioPhysics group, Max Planck Institute for Multidisciplinary Sciences, Göttingen 37077, Germany

Single-molecule and particle-tracking experiments interrogate physical observables along individual trajectories, and the experiments are typically analyzed by time-averaging along individual realizations. In this sample-path based setting the so-called *empirical density* and *empirical current* correspond to estimators of the probability density and probability current in ensemble statistical mechanics. In the talk I will review our recent efforts on how to describe and understand fluctuations of path-based observables in systems driven out of equilibrium across the dimensions, highlighting the crucial role of coarse graining in space. I will argue that albeit technically convenient and perhaps intuitively appealing and thus popular, any attempts to generalize the insight gained from 1-dimensional examples should be made with care. In particular, the dynamical fluctuation behavior in dimension 1 must *not* be considered to be representative of higher dimensions.

References

[1] C. Dieball & AG, *Phys. Rev. Lett.* **129**, 140601 (2022)

[2] C. Dieball & AG, *Phys. Rev. Research* **4**, 033243 (2022)

[3] C. Dieball & AG, *J. Phys. A: Math. Theor.* **55**, 475001 (2022)

* agodec@mpinat.mpg.de