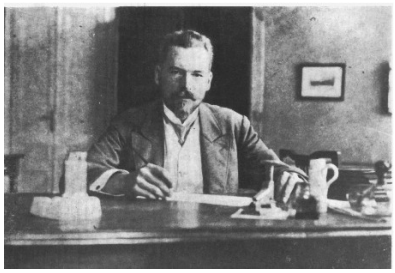

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Surviving on the edge of instability

Properties of stochastic dynamics in highly unstable potentials are strongly influenced by divergent trajectories, which quickly leave meta-stable regions and never return there. Using formalism from the theory of Q-processes and quasi-stationary distributions, we discuss distributions of non-diverging trajectories in highly unstable potentials. We focus on two stationary distributions which can be considered as (formal) generalizations of the Gibbs canonical distribution to the case of highly unstable dynamics. Even though the associated effective potentials differ only slightly, properties of the two distributions are fundamentally different for all highly unstable potentials. The distribution of trajectories conditioned to be never divergent is localized and light-tailed. The distribution describing trajectories surviving in the meta-stable region at the instant of conditioning is heavy-tailed. The exponent of the corresponding power-law tail is determined by the leading divergent term of the unstable potential. We also derive properties of the effective force arising in the ensemble of non-diverging trajectories. The presented results are applicable to a broad class of non-linear dynamical models with meta-stable states and fast kinetic transitions.

Summary

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