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Fluctuation loops in a noise-driven linear circuit model STEPHEN TEITSWORTH, AKHIL GHANTA, JOHN NEU, Duke University — Understanding the spatio-temporal structure of most probable fluctuation pathways to rarely occurring states is a central problem in the study of noise-driven, non-equilibrium dynamical systems. When the underlying system does not possess detailed balance, the optimal fluctuation pathway to a particular state and relaxation pathway from that state may combine to form a loop-like structure in the system phase space which we call a *fluctuation loop*. Here, we study fluctuation loops in a linear circuit model consisting of coupled RC elements, where each element is driven by its own noise source and, generally, the effective noise strengths of different elements are not equal. Using a stochastic Hamiltonian approach, we determine the optimal fluctuation pathways, and construct corresponding fluctuation loops. Analytical results agree closely with suitably averaged simulation results based on the associated Langevin equation. To better characterize fluctuation loops, we study the time-dependent area tensor that is swept out by individual stochastic trajectories in the system phase space. At long times, the area tensor scales linearly with time, with a coefficient that precisely vanishes when the system satisfies detailed balance.

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