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Driven-dissipative coupled Ising models: a new non-equilibrium universality class JEREMY T. YOUNG, Joint Quantum Institute, MICHAEL FOSS-FEIG, Army Research Lab, ALEXEY V. GORSHKOV, Joint Quantum Institute, MOHAMMAD F. MAGHREBI, Michigan State University — Driven-dissipative systems can potentially exhibit non-equilibrium phenomena that are absent in their equilibrium counterparts. However, phase transitions present in these systems generically exhibit an effectively classical, equilibrium behavior in spite of their non-equilibrium origin. We investigate an experimentally motivated model where two Ising-like order parameters interact and form a multicritical point. Using perturbative renormalization group techniques, we show that a pair of inherently non-equilibrium multicritical points emerge. These non-equilibrium multicritical points exhibit a variety of exotic phenomena with no counterpart in equilibrium, including spiraling phase boundaries, the emergence of discrete scale invariance rather than the more familiar continuous scale invariance, and the violation of the fluctuation-dissipation theorem at all length scales, resulting in a system which becomes hotter and hotter at longer and longer wavelengths. Furthermore, we find that for more complex order parameters with a different form or symmetry, additional non-equilibrium multicritical points emerge.

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