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Parity-time symmetry breaking in magnetic systems ALEXEY GALDA, James Franck Institute, University of Chicago, VALERII VINOKUR, Materials Science Division, Argonne National Laboratory — The understanding of out-of-equilibrium physics, especially dynamic instabilities and dynamic phase transitions, is one of the major challenges of contemporary science, spanning the broadest wealth of research areas that range from quantum optics to living organisms. Focusing on nonequilibrium dynamics of an open dissipative spin system, we introduce a non-Hermitian Hamiltonian approach, in which non-Hermiticity reflects dissipation and deviation from equilibrium. The imaginary part of the proposed spin Hamiltonian describes the effects of Gilbert damping and applied Slonczewski spin-transfer torque. In the classical limit, our approach reproduces Landau-Lifshitz-Gilbert-Slonczewski dynamics of a large macrospin. We reveal the spin-transfer torque-driven parity-time symmetry-breaking phase transition corresponding to a transition from precessional to exponentially damped spin dynamics. Micromagnetic simulations for nanoscale ferromagnetic disks demonstrate the predicted effect. Our findings can pave the way to a general quantitative description of out-of-equilibrium phase transitions driven by spontaneous parity-time symmetry breaking.

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