

Long-range order induced by superdiffusion of classical XY spins

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Motivated by observations of synchronization of motile chemical and biological oscillators, we study an ensemble of random walkers in two dimensions carrying an internal noisy clock which is synchronized among the walkers by local interaction. This system corresponds to an ensemble of moving classical XY spins. We consider two mobility patterns for the walkers: normal diffusive motion and Levy flights. In particular, we investigate the crucial influence of the mobility pattern on the nonequilibrium phase transition from incoherence to synchronization focusing on the large system limit. For normally diffusing oscillators, a finite-size scaling analysis reveals a Berezinskii-Kosterlitz-Thouless transition from incoherence to quasi long-range order. In contrast, we show that Levy flight motion induces a continuous phase transition to synchronization and long-range order in two dimensions.