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Dynamic Phases, Clustering, and Lane Formation for Driven Disk Systems in the Presence of Quenched Disorder YANG YANG, DANIELLE MCDERMOTT, Wabash College, CYNTHIA J. OLSON REICHHARDT, CHARLES REICHHARDT, Los Alamos National Laboratory — We numerically examine the dynamic phases and pattern formation of 2D monodisperse repulsive disks driven over random quenched disorder. We show that there is a series of distinct dynamic regimes as a function of increasing drive, including a clogged or pile-up phase near depinning, a homogeneous disordered flow state, and a dynamically phase separated regime consisting of high density crystalline regions surrounded by a low density of disordered disks. At the highest drives the disks arrange into 1D moving lanes. The phase separated regime has parallels with phase separation observed in active matter systems, and arises in the disk system due to the combination of nonequilibrium fluctuations and density dependent mobility. We discuss how this system exhibits pronounced differences from previous studies of driven particles moving over random substrates where the particles, such as superconducting vortices or electron crystals, have longer range repulsive interactions, and where dynamical phase separation and strong one-dimensional moving chain effects are not observed. The system we consider could be realized experimentally using sterically interacting colloids driven over random pinning arrays or quasi-two-dimensional granular matter flowing over rough landscapes.

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