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Stochastic dynamics and phase-field roughening in optomechanical oscillator arrays ROLAND LAUTER, University of Erlangen-Nuremberg, ADITI MITRA, New York University, FLORIAN MARQUARDT, University of Erlangen-Nuremberg — We consider arrays of coupled optomechanical systems, each of which consists of a laser-driven optical mode interacting with a mechanical (vibrational) mode. For sufficiently strong laser driving, the mechanical modes can settle into stable finite-amplitude oscillations on a limit cycle. We study the collective classical nonlinear dynamics of the phases of these oscillators, which is effectively described by an extension of the well-known Kuramoto model. In this extended model, we study the effect of noise on the dynamics in the case of homogeneous-phase initial conditions. We analytically establish a connection to the physics of surface growth as described by the Kardar-Parisi-Zhang model. Simulations of one-dimensional arrays of our model indeed show roughening of the phase field and universal scaling of the phase-field width. In contrast to the continuum Kardar-Parisi-Zhang model, our model is a genuine lattice model. We discuss interesting effects due to this difference, including crossover timescales and the role of instabilities of the roughening process.

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