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Vortices in the 2D Kuramoto model TONY LEE, HEYWOOD TAM, GIL REFAEL, Department of Physics, California Institute of Technology, JEFFREY ROGERS, Microsystems Technology Office, Defense Advanced Research Projects Agency, MICHAEL CROSS, Department of Physics, California Institute of Technology — We study the synchronization of oscillators in 2D lattices with nearest neighbor coupling. The boundaries between synchronized domains are due to the motion of vortices. Since the phase winds by 2π around a vortex, it generates 2π phase slips between oscillators across its path. Thus, the synchronization behavior of the system can be viewed in terms of the production, movement, and annihilation of vortex pairs. Although the Kuramoto model is nonlinear, we show how to use the steady state solution of the linearized model to predict where the vortices are produced and how they move. We also study vortex density as a function of system size and coupling. This vortex approach may lead to an analytical understanding of why the lower critical dimension for macroscopic entrainment is 2.

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