# Nonequilibrium Dynamic Vortex Phases

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## Abstract

The new dynamic phase diagram for driven vortices with varying lattice softness we present here indicates that, at high driving currents, at least *two distinct dynamic phases* of flux flow appear depending on the vortex-vortex interaction strength. When the flux lattice is soft, the vortices flow in independently moving channels with smectic structure. For stiff flux lattices, adjacent channels become locked together, producing crystalline-like order in a coupled channel phase. At the crossover lattice softness between these phases, the system produces a maximum amount of voltage noise. Our results relate spatial order with transport and are in agreement with experiments.

We also analyze the microscopic dynamics of vortex motion through channels that form river-like fractal networks in a variety of superconducting samples, and relate it to macroscopic measurable quantities such as the power spectrum [1]. As a function of pinning strength, we calculate the fractal dimension, tortuosity, and the corresponding voltage noise spectrum. Above a certain pinning strength, a remarkable phase-transition-like *universal drop* in both tortuosity and noise power occurs when the vortex motion changes from shifting braiding channels to unbraided channels.

1. C.J. Olson, C. Reichhardt, and F. Nori, Phys. Rev. Lett. 80, 2197 (1998); and preprint.