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Phase-slip avalanches in the superflow of ^{4}He through arrays of nano-apertures DAVID PEKKER, ROMAN BARANKOV, PAUL M. GOLDBART, University of Illinois at Urbana Champaign — Recent experiments have explored the dynamics of ^{4}He superflow through an array of nano-apertures [1]. These experiments have found that, as the temperature is lowered, phase-slippage in the apertures changes its character from synchronous to asynchronous. Here, we construct a model [2] of the superflow that incorporates two basic ingredients: (a) disorder associated with each aperture having its own random critical velocity, and (b) an effective inter-aperture coupling, mediated through the bulk superfluid, which stimulates the apertures in the neighborhood of an aperture that has already phase-slipped also to slip. We find that at lower temperatures the synchronicity is lost, due to broadening of the distribution of the critical velocities associated with the reduction of the superfluid healing length. We also observe that as the disorder becomes weak, compared to the inter-aperture coupling, there is a non-equilibrium transition from a regime of small phase-slip avalanches to a regime in which interactions between phase-slips in nearby apertures lead to system-wide phase-slip avalanches.

[1] Y. Sato, E. Hoskinson, and R. E. Packard, Phys. Rev. B **74**, 144502 (2006).
[2] D. Pekker, R. Barankov, and P. M. Goldbart, cond-mat/0606560.

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