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The Effects of Colored Quadratic Noise on a Turbulent Transition in Liquid ^{4}He[1]

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Liquid ^{4}He presents an important physical system for the experimental study of noise-induced dynamical transitions. At temperatures below T_λ, in the He II phase, the flow of heat in the liquid helium is limited by a kind of superfluid turbulence. The steady-state properties of this turbulence are adequately described by a dense tangle of quantized vortex lines in the superfluid component of the He II. The turbulence undergoes a continuous transition as the heat current is increased. At this transition the intrinsic fluctuations in the dissipation and the relaxation time both become large [D. Griswold, C. P. Lorenson, and J. T. Tough, *Phys. Rev. B* **35**:3149 (1987)]. These observations are consistent with a model of the transition as an imperfect pitchfork bifurcation [M. Schumaker and W. Horsthemke, *Phys. Rev. A* **36**:354 (1987)]. External noise can be easily added to the driving heat current. Small-amplitude noise simply causes the system to fluctuate about the deterministic steady states. Large-amplitude noise causes dramatic changes. The stochastic steady states of the turbulence show noise-induced bistability [D. Grisowld and J. T. Tough, *Phys. Rev. A* **36**:1360 (1987)]. Comparison with the imperfect pitchfork model is difficult because the noise is colored, quadratic, and large. Nevertheless, an approximate result obtained by Schumaker and Horsthemke is in good qualitative agreement with the data.

KEY WORDS: Superfluid turbulence; noise-induced transitions; quadratic noise.

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