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Emergence of puffs, weak and strong slugs from a stochastic predator-prey model for transitional turbulence with stream-wise shear interactions[1] XUEYING WANG, University of Illinois at Urbana-Champaign, HONG-YAN SHIH, Institute of Physics, Academia Sinica, NIGEL GOLDENFELD, University of Illinois at Urbana-Champaign — In transitional pipe turbulence, a sequence of phases is observed experimentally in the range of Reynolds numbers between 1900 and 5000, passing through the laminar-turbulent transition at Re 2040. These phases are characterized by transient decay of puffs (Re ¡ 2040), puff-splitting and propagation (2040 ¡ Re ¡ 2250), expansion of turbulent regions via weak slugs (asymmetric upstream and downstream fronts, 2250 ¡ Re ¡ 4500), and via strong slugs (symmetric upstream and downstream fronts, Re ¿ 4500). In earlier work, an intrinsically stochastic model for puff-decay and splitting accounted for the corresponding single-puff super-exponential timescales. This model was focused on the dynamics and fluctuations within a single puff and did not include stream-wise interactions arising through shear. Here we extend this model in a generic way to include these neglected interactions and show that the resulting model recapitulates the full phase diagram of the transition, successfully capturing the weak and strong slug behavior. The model is not restricted to one dimension and is extendable to other transitional shear flows.

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