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A low-dimensional population-competition model for analyzing transverse optical patterns[1] Y.C. TSE, M.H. LUK, Physics Department, Chinese University of Hong Kong, N.H. KWONG, College of Optical Sciences, University of Arizona, P.T. LEUNG, Physics Department, Chinese University of Hong Kong, S. SCHUMACHER, Physics Department and Center for Optoelectronics and Photonics Paderborn, University of Paderborn, R. BINDER, College of Optical Sciences and Department of Physics, University of Arizona — Under favorable conditions, laser beams passing through a nonlinear medium (e.g. atomic vapors) can undergo directional instabilities, generating transverse optical patterns in the far field. In particular, a low intensity all-optical switching scheme using these transverse patterns in semiconductor quantum well microcavities was numerically demonstrated. Trying to understand the switching mechanism through the simulation results has turned out to be a complicated task. In this Contribution, we present a low-dimensional "population-competition' model that (i) exhibits nearly all the pattern selection and switching behaviors and (ii) is simple enough to allow a comprehensive analysis of its solution structure in the relevant region of parameter space. We will explain the relation between this simple model and the realistic theory. Using elementary methods in Catastrophe Theory, we analyze the "phase diagrams" of our model's steady state solutions in parameter space, with the help of which we construct an organized picture of the behaviors of the realistic simulation results.

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