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A field-theoretic approach to the May-Leonard cyclic population dynamics model SHANNON R SERRAO, Department of Physics, Virginia Tech, UWE C TÄUBER, Virginia Tech — Spatially extended stochastic population dynamics models with cyclic predation interactions display intriguing time evolution and spontaneous structure formation. We study a general May-Leonard cyclic competition model in d dimensions with diffusive particle propagation. We use the second-quantized Doi-Peliti formalism and ensuing coherent-state path integral representation to construct its continuum representation and explore its collective dynamics. Expanding the resulting action about the mean-field species concentrations enables us to compute the diagonalized harmonic propagators and hence relaxation rates and oscillation frequencies. Furthermore, we identify the constraints necessary for time scale separation that allows us to project out the purely relaxing eigenmode. The remaining oscillating fields obey the complex Ginzburg-Landau equation, which is consistent with spiral pattern formation. We determine the parameter regimes for our stochastic model that lead to the emergence of spiral patterns, and for which the time-dependent complex Ginzburg-Landau equation with additive white noise provides an adequate (reduced) description.

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