# Spontaneous patterns in discrete nonlinear Schrödinger equations : spatial instabilities in periodic optical systems

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**TALK ABSTRACT**

The spontaneous emergence of finite-amplitude spatial patterns such as hexagons and squares is well-known in the field of laser optics. Two configurations that have been extensively studied are the *ring cavity* and *counterpropagating-beams* scenarios. In the former, a circulating light beam is confined between a set of mirrors; in the latter, two overlapping waves travel in exactly-opposite directions. The nonlinear medium supporting pattern formation is typically assumed to be uniform.

Here, we consider generalizing these two systems to regimes that accommodate periodicity in the medium's dielectric response. Equations describing diffraction in such structures are often formulated using coupled-mode theory, anticipating nearest-neighbour interactions and subsequently yielding discrete nonlinear Schrödinger-type models. In contrast with other analyses, we avoid deployment of the widely-used mean-field approximation. Attention will focus mainly on cases where there is a single transverse coordinate so that the ring-cavity waveguide is ultimately governed by a (1+1)D equation. Counterpropagation, however, requires the solution of a more difficult (1+2)D problem. A derivation will be given of the threshold instability spectra for spatial patterns, and the asymptotic recovery of known continuum results demonstrated in the long-wavelength limit. Supporting numerical work will also be presented, confirming recent theoretical predictions of the most-unstable Fourier mode.