
Non-Hermitian coupling of semiconductor nanolasers

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Abstract

Non-Hermitian physics has become a powerful framework to describe light–matter systems where gain, loss, and radiative coupling play an essential role. Beyond its original connection to parity–time symmetry, it now underpins the study of exceptional points, non-orthogonal eigenmodes, and direction-dependent transport—all highly relevant to photonic platforms.

In this talk, I will focus on a recently developed III–V nanolaser platform integrated on silicon, where individual sub-micron cavities are *distantly* coupled through a shared silicon channel. This waveguide-mediated interaction differs qualitatively from conventional near-neighbour evanescent coupling: it allows flexible control of both the magnitude and the phase of the complex coupling between the lasers.

I will present how this system exhibits a rich set of nonlinear collective behaviours—including bistability, mode competition and synchronization—arising from the interplay of gain saturation, carrier-induced refractive index shifts, and delayed coupling. As a highlight, I will discuss our recent observation of **Q-switched pulsing** in this system, a dynamical regime in which the array self-organizes into periodic pulses of light with sub-nanosecond pulsewidths.

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