Presentation

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Origin of the linewidth enhancement factor: Resonant processes behind optical frequency comb formation

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Abstract

A phenomenological linewidth enhancement factor (LEF) was recently used to explain a variety of laser dynamics, from free-running optical frequency combs (OFCs) to solitonic-structures in quantum cascade lasers (QCLs). In this work, we provide a physical origin of the LEF for the first time. The inclusion of scattering assisted optical transitions leads to considerable asymmetry of the gain lineshape, which induces a finite LEF. A k-space resolved density matrix model that incorporates multiple elastic and inelastic scattering mechanisms was used. A laser master equation including LEF is derived that shows OFC formation and provides a link to Kerr microresonators.

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