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Frequency combs and temporal solitons in a coherently driven ring quantum cascade laser

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We propose a generalization of the well-known Lugiato-Lefever Equation to unify the description of combs- and structures- forming nonlinear optical systems. This approach rigorously connects for the first time passive systems such as Kerr micro-resonators and active systems such as Quantum Cascade Lasers (QCLs) which were so far treated separately. The model effectively describes a unidirectional ring QCL driven by a coherent signal where we show the existence of temporal solitons and Turing rolls, previously identified only in Kerr micro-resonators, considerably increasing the theoretical insight and the technological potential of chip-scale comb sources.

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