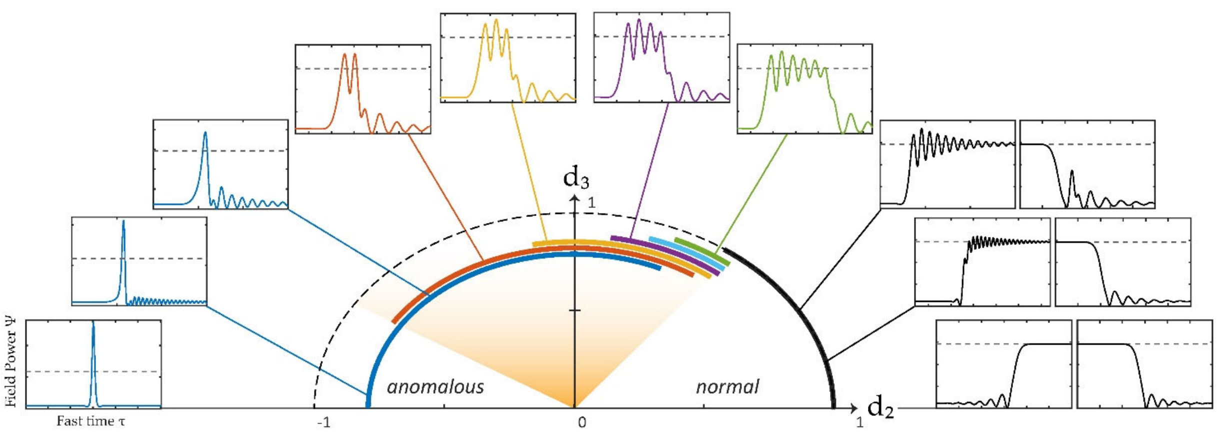
Miles Anderson

Alexey Tikan, Aleksandr Tusnin, Grigory Lihachev, Johann Riemensberger, Tobias J. Kippenberg
EPFL, Lausanne, Switzerland

Universal Dissipative Kerr Structure Generation in Pulse-Driven Microresonators !

Passively driven Kerr cavities have become a well-studied testbed for fundamental optical dynamical systems and, in the form of chip-integrated microresonators, a source for broadband frequency combs. Within the broad category of 'localised dissipative structures' (LDS) that can be generated within these microresonators, dissipative solitons, which exist in pure anomalous group-velocity dispersion (GVD), are the most well studied. If we expand our view across all values of GVD (with a fixed residual third-order dispersion) we see that three broad categories of LDS exist: dissipative solitons at anomalous dispersion, switching waves at normal dispersion, and zero-dispersion solitons across the interval in pure-third order dispersion. All such LDS can be generated directly, as solitary structures, within a synchronous pulse-driven Kerr cavity system. Each of the three varieties of LDS have features that distinguish one from the other, forming different types of frequency comb profile. In this work we explore, in theory and experiment, the different LDS microcombs possible in photonic Si_3N_4 microresonators, including such LDS carrying higher-order dispersive waves broadening the spectrum to an octave in bandwidth, carrying thousands of come teeth at microwave (15-30 GHz) spacing.



Localised dissipative structures that exist in Kerr cavities across the GVD phase space. d_2: group-velocity (second-order) dispersion, d_3: third-order dispersion. Clockwise from left: dissipative solitons, dissipative solitons with dispersive tail, zero-dispersion solitons of period -2, 3, 4+, switching wave fronts with dispersive wave tail, switching waves.

References

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