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Self-start of passively mode-locked ring fibre oscillator as a function of pump power

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Paper Abstract

This work presents for the first time the results of study of one of the simplest and most reliable configurations of a ring fibre laser passively mode-locked due to nonlinear polarisation evolution. The laser arrangement under consideration comprises a single phase retarding element in contrast to most widely used configurations with several wave plates or two polarisation controllers. By means of numerical simulation based on coupled non-linear Schr ödinger equations for orthogonal polarisation components, we investigate mode-lock domain in terms of pump power and phase delay introduced by the single polarisation control element. Changing pump power, we demonstrate the capacity of such a simple cavity layout with only one polarisation element to operate in different lasing regimes including generation of conventional laser pulse trains at the fundamental repetition rate, generation of double-scale partially coherent and noiselike pulses and generation of multiple pulses per round-trip. Besides the results of a detailed numerical study, we also announce experimental results obtained from an Er fibre laser with a single polarisation controlling element based on an electronically driven liquid crystal. Our experimental observations are in good qualitative agreement with simulation results and constitute a platform for creation of new simple, low-cost, and reliable self-starting fibre lasers with ultrashort optical pulses.

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