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(G*) Adding a linear contribution to depolarization in simulations of supercontinuum generation

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Supercontinuum generation in optical fiber is the result of an interplay between multiple nonlinear processes. Simulations to reproduce experimental observations are well documented: a differential equation known as the generalized nonlinear Schrödinger equation (GNLSE) is solved to determine the effect of propagation on the spectral and temporal profiles of the slowly-varying amplitude of a laser pulse. For the scalar case, the GNLSE has been shown to yield good results. In a more accurate case, it becomes necessary to take into account the polarization evolution of light as it travels through the fiber, for instance for a fiber with two orthogonal principal axes. This is typically added into the GNLSE to form coupled equations including the birefringence of the fiber and additional nonlinear terms coupling the slowly-varying amplitudes of two polarization components. Upon studying the experimental spectra obtained from a germania-doped photonic crystal fiber, we observe that the polarization state varies significantly across the spectrum, leaving the spectral edges with a greater degree of polarization than the areas near the input pump wavelength. We also observe that the spectral region around the pump maintains a low degree of polarization. These trends lead us to believe that a portion of the energy transfer from input polarization state to an orthogonal output state is proportional to the propagation length, consistent with a linear depolarization contribution that cannot be reproduced using only nonlinear equations. We therefore demonstrate the effect of an additional depolarization term to account for the redistribution of energy between polarization modes. Furthermore, the interaction between linear and nonlinear depolarization mechanisms leads to a more realistic estimate of the polarization maintaining capability of an optical fiber over a broadband spectrum.

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