ULTRAFAST ALL-OPTICAL SWITCHING USING DUAL-CORE PHOTONIC CRYTSAL FIBERS

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In this presentation we will overview our research conducted during the forgoing years in area of soliton propagation in dual-core optical fibers with perspective of nonlinear all-optical switching. High amount of theoretical papers supposed exciting all-optical switching possibilities in solitonic propagation regime of dual-core photonic crystal fibers (DC PCF) in the last decades. Therefore, we study experimentally this propagation regime in order to explore the application potential of this underdeveloped approach from the practical point of view. The key enabling aspects of our research are the multicomponent glass PCF technology available in-house for PCF fabrication, the access to unique ultrafast infrared sources and the supporting dedicated numerical simulation background.

Three important steps on the way of high-contrast DC PCF based solitonic switching will be introduced in the frame of this talk. The early work focused on a lead-silicate square lattice DC PCF enabled interesting switching possibilities at non-excitation wavelengths in controllable manner. Thanks to the simultaneously evolving extensive simulation work a novel concept were elaborated supporting broadband high-contrast switching based on self-trapping of high-order solitons. This second step was achieved by considering new fiber material with one order of magnitude higher nonlinear refraction index. The fabrication of the optimized fiber structure and its experimental investigation represents the third step. Thanks to that, contrast improvement of the spectral intensity switching was demonstrated using the new fiber at simultaneous decrease of the energies of the femtosecond switching pulses, available already in the sub-nJ range [1].

According to our analysis the significant dual-core asymmetry of the DC PCF structure prevented the realization of the envisaged broadband switching behavior, which would be even larger step forward. Therefore recently we work on a new approach, taking benefit from the all-solid PCF technology promising better structure preservation and higher dual-core symmetry. Finally, some preliminary results about these recent efforts will make round the overview.

Acknowledgement: This work has been supported by the Polish National Science Center, grant no UMO-2016/22/M/ST2/00261, titled „Nonlinear interaction of structured light beams with matter"