Self-similarity in Fiber Optics

Optical solitons, light pulses/beams that maintain both their shapes and linear dimensions during propagation inside a nonlinear medium, have been widely studied to date. However, a more general class of shape-preserving waves includes **self-similar waves**, which maintain their shape but not linear dimensions during propagation in nonlinear media. We have recently analytically described self-similar evolution of ultrashort pulses in dispersion-managed nonlinear optical fibers and fiber amplifiers. We showed that there exists a one-to-one correspondence between such self-similar pulses and solitons of homogeneous nonlinear fibers. As this correspondence guarantees the stability of the novel self-similar waves, we refer to them as **similaritons**. We demonstrated that, the character of similariton interactions crucially depends on the sign of the similariton phase chirp. We showed that the similariton interactions can even lead to the formation of molecule-like bound states of two similaritons, illustrated below. Our results can find applications to fiber optical communications and information transfer.

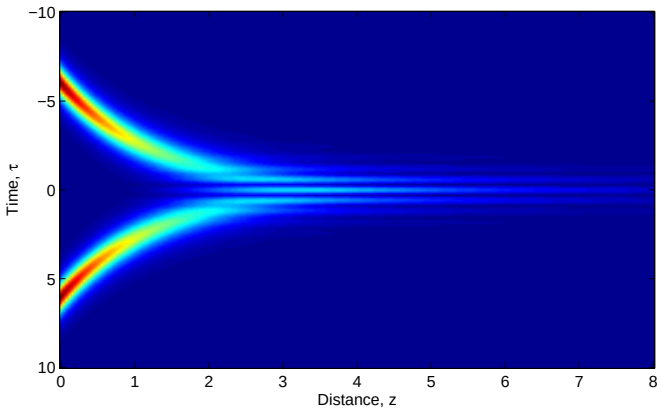

Fig. 1. Two-similariton state formation upon collisions in a dispersion decreasing fiber.

References and links

1. S. A. Ponomarenko and G. P. Agrawal, "Interactions of chirped and chirp-free similaritons in optical fiber amplifiers", *Opt. Express*, **15**, 2963 (2007).
