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# Averaged-dispersion management for ultrashort solit on molecule propagation in lossy fibre systems

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#### Abstract

In this study we successfully designed ultrashort soliton molecales, required for ultra-high-speed fibre transmission systems, by means of average dispersion managementing the presence of losses and periodic amplification. We also conducted a systematic numerical investigation of the individual and combined impacts of third-order dispersion, self-steepening and stimulating and scattering on the behaviour of two- and threesoliton molecules in the femtosecond regime, in articular, with respect to the breathing factor. We show that all the considered higher-order effects substantially binder the propagation of soliton molecules. Finally, we suggest that optimal third-order dispersion contraction, combined with a correct choice of the breathing factor, may allow reduction of the penalties due to self-steepening and stimulated Raman scattering. *Keywords:* Optical fibres, Soliton mathematical verage-dispersion management, Nonlinear Schrödinger

equation, Higher-order effects

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#### 1. Introduction

Bound states of solve  $\cdot$  s are quite common in optical fiber systems where they display a great variety of shape profile (see for instance [1, 2, 3, 4]). Among this class of multi-soliton structures, soliton molecules (Sive  $\cdot$  h<sup>2</sup> ve received a particular attention since the first experimental evidence in dispersion-mataged ( $\cdot$  M) fibers [5], and the subsequent demonstration of their potential to expand the transmission correctly in optical communication systems [6, 7]. Research on SMs and their application in cotical communications face numerous challenges. On the technological front, research activities

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