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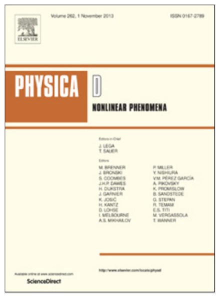

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Dispersion managed solitons in the presence of saturated nonlinearity

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Abstract

The averaged dispersion managed nonlinear Schrödinger equation with saturated nonlinearity is considered. It is shown that under rather general assumptions on the saturated nonlinearity, the ground state solution corresponding to the dispersion managed soliton can be found for both zero residual dispersion and positive residual dispersion. The same applies to diffraction management solitons, which are a discrete version describing certain waveguide arrays.

1. Introduction

1.1. Background

The dispersion managed nonlinear Schrödinger equation (DM NLS) by now is a well established model in nonlinear science. There is a good review article on the subject by Turitsyn-Brandon-Fedoruk [17]. Initially, the main motivation to study this equation came from fiber optics applications, after the introduction of the dispersion compensation technique (which itself appeared due to the invention of fibers with anomalous dispersion). Nowadays, DM NLS became a paradigm of a nonlinear dispersive equation with periodically varying coefficients that in some regime, e.g. strong dispersion management, leads to a dispersion averaged nonlinearity. This nonlocal equation and its solutions can easily have properties which are qualitatively different from what one is used from the local NLS. For example, it can have ground states which have strongly oscillating tails, see [16]. One should also note an interesting related development in pure mathematics where several works have appeared on best constants in space-time inequalities, such as the celebrated Strichartz inequality [3, 4, 14, 9, 15, 10], which are related to dispersion managed solitons.

The evolutionary equation for the propagation of the wave envelope of an optical pulse in a single mode fiber is given by [11, 1]

$$\mathrm{i}u_t + \left(\alpha + \frac{1}{\epsilon} d\left(\frac{t}{\epsilon}\right)\right) u_{xx} + \gamma\, f(|u|)u = 0,$$