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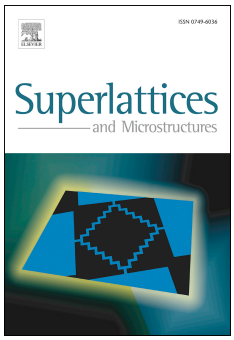

Dark, bright and other soliton solutions to the Heisenberg ferromagnetic spin chain equation

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Dark, bright and other soliton solutions to the Heisenberg ferromagnetic spin chain equation

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Abstract

In this study, the applications of the extended sinh-Gordon equation expansion method to a nonlinear Schrödinger equation that describes the nonlinear spin dynamics of (2+1)-dimensional Heisenberg ferromagnetic spin chains with bilinear and anisotropic interactions in the semiclassical limit is presented. We successfully construct dark, bright, combined dark-bright, singular and combined singular soliton solutions to this equation. We give the parametric conditions for the existence of valid soliton to each of the obtained solutions. We plot the 2D and 3D graphics to some of the obtained solutions. The reported results of this study may be helpful in explaining the physical meaning of the studied model.

Keywords: The Extended ShGEEM; ferromagnetic; soliton solutions

1 Introduction

Nonlinear Schrödinger equations (NLSEs) are widely used to describe complex aspects in different fields of nolinear sciences, such as optical fibers, fluid dynamic, plasma physics and so on [1, 2]. Optical solitons are localized electromagnetic waves that spread in nonlinear dispersive media and leave the intensity unchanged due to the stability between dispersion and nonlinearity effects [3]. Optical solitons have been regarded as the next generation technology for high-capacity optical communications, mainly because of their promise to transmit signals over long distances while resisting chromatic dispersion [4]. Many integration schemes have been used in investigating various soliton solutions in various type of NLSEs. Afzal *et al.* [5] employed the extended direct algebraic method in investigating a nonlinear Schrödinger equation under anti-cubic. Eslami [6] studied the (1+2)-dimensional chiral nonlinear Schrödinger's equation by using the trial solution scheme. Kumar *et al.* [7] secured the exact spatiotemporal periodic travelling wave solutions to the generalized (3+1)-dimensional cubic-quintic nonlinear Schrödinger equation with spatial distributed coefficients. Belić *et al.* [8] obtained the analytical light bullet solutions to the generalized (3+1)-dimensional nonlinear Schrödinger equation. Zayed *et al.* [9] investigated the soliton solutions to the nonlinear Schrödinger equation with fourth-order dispersion and dual power law nonlinearity. In generally, several mathematical approaches have been developed in this context [10–25].