Interface vortex solitons in quadratic photonic lattices

Zhiyong Xu
Nonlinear Physics Center, Research School of Physics and Engineering, Australian National University, Canberra, ACT 0200, Australia
Tel: +61-2-6125-7849, email: xzy124@physics.anu.edu.au

Abstract:

In this talk, we will address the properties of vortex solitons supported by an interface between two distinct optical lattices imprinted in nonlinear quadratic media. We analyze the impact of guiding parameters of lattices and phase mismatching conditions on the existence and stability of two-color interface vortex solitons.

Surface modes appear as a special type of waves localized near an interface separating two different media. In optics, linear electromagnetic surface waves are known to exist at an interface separating homogeneous and periodic media [1]. Recently, the interest in the study of electromagnetic surface waves has been renewed, and it was shown that periodic waveguide arrays can support discrete surface solitons. It is interesting to note that a novel type of surface modes with screw phase dislocation [2] can be formed at the interface between dissimilar periodic media [3]. Surface solitons have been normally considered in cubic or saturable nonlinear media, however, recently it is shown that surface solitons can be formed in nonlinear quadratic media [4, 5].

In this work, for the first time to our knowledge, we consider vortex solitons supported by an interface between two distinct optical lattices imprinted in nonlinear quadratic media. It is shown that quadratic lattices support rich families of surface states with a phase dislocation, including both on-site and off-site vortex solitons. The salient point is that profiles of interface vortex solitons are highly asymmetric and non-canonical, which are normally the feature of solitons supported at the interface of heteo-photonic waveguides [5]. We analyze the impact of guiding parameters of lattices on the existence and stability of interface vortex solitons in different phase mismatching conditions, and show that there exist lower and upper cutoff values of the propagation constant for the formation of vortex solitons. There also exists a narrow instability region near the lower cutoff value of the propagation constant, while interface vortex solitons are completely stable in the existence domain close to the upper cutoff of the propagation constant.

References:

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