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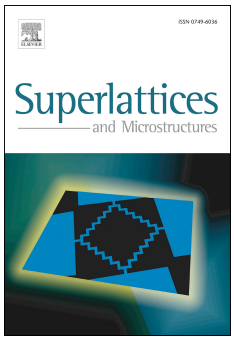

Negative refraction index of the quantum lossy left-handed transmission lines affected by the displaced squeezed Fock state and dissipation

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Negative refraction index of the quantum lossy left-handed transmission lines affected by the displaced squeezed Fock state and dissipation

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Abstract

Quantum lossy left-handed transmission lines (LHTLs) are central to the miniaturized application in microwave band. This work discusses the NRI of the quantized lossy LHTLs in the presence of the resistance and the conductance in a displaced squeezed Fock state (DSFS). And the results show some novel specific quantum characteristics of NRI caused by the DSFS and dissipation, which may be significant for its miniaturized application in a suit of novel microwave devices.

Keywords: Negative refraction index, quantum lossy left-handed transmission lines, a displaced squeezed Fock state

1. Introduction

In one dimension, left-handedness is described as the double opposite orientations between the wave vector $\vec{k}$ and Poynting vector, the phase and group velocity corresponding to the dispersion relation $\partial\omega(k)/\partial k < 0$[1]. The left-handedness in the LHTL can be achieved by a discrete array of series capacitors and parallel inductors[2, 3, 4](Fig.1), which remains the metamaterial via the array of series dual interchanged inductors and capacitors other than the usual discrete representation of the right-handed transmission line (RHTL). LHTL is perhaps one of the most representative and potential candidates due to its non-resonant type with low loss, broad operating frequency band, as well as planar configuration[5, 6], which is often related with easy fabrication for NRI applications in a suite of novel guided-wave[7], radiated-wave[8], and refracted-wave devices and structures[9, 10].

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