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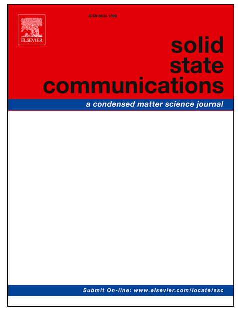

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Sub-diffusive spreading and anomalous localization in a 2D Anderson Model with off-diagonal nonlinearity

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Abstract

We study the electronic wavepacket dynamic in a two-dimensional lattice under the influence of off-diagonal nonlinearity in the regime of diagonal disorder larger than the crystalline bandwidth. By using numerical calculations of the participation function, the mean square displacement and the return probability, we show that the nonlinearity induces a sub-diffusive spreading of the wavepacket. We also report the existence of an anomalous nonlinear strength at which the wavepacket remains strongly localized.

Keywords:
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1. Introduction

One of the fundamental phenomenon in solid state physics is related to the electronic wavepacket propagation in disordered structures. The localization theory, pioneered by P.W. Anderson, points out the localized nature of a non-interacting electron wavepacket due to a strong diagonal disorder [1, 2, 3]. Although the initial proposal has been devoted to electronic properties, the phenomenon of wave localization in disordered media has been observed in several other branches, such as electromagnetic [4, 5] and acoustic [6] waves.

In particular, studies of matter waves localization [7] have provided an excellent framework to answer challenging open questions of condensed matter. A remarkable characteristic in these systems is the relevance of nonlinear effects. In particular, the evolution of a Bose-Einstein Condensate can be described by using the nonlinear Gross-Pitaevskii equation [8]. On the other hand, the nonlinearity in the Schrödinger equation of electronic systems has its origin in the electron interaction with the vibrational modes of the lattice [9, 10]. This mechanism is of great interest in state solid physics, since the presence of nonlinearity may trap a wavepacket in a finite fraction of the lattice, a phenomenon called self-trapping [9, 10]. It occurs when the strength of the nonlinearity