Visualization of topological edge modes in mechanical graphene

Gun Yoon

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Abstract

abstract

한국어

1 Introduction

Breaking time-reversal (TR) symmetry known as to cause the energy gap to open at the Dirac point[4]. By breaking TR, we can introduce topologically protected modes on the material. These topologically protected modes is one of the most important factor for the unique quantum phenomena such as a topological magneto-electri effect, an image magnetic monopole effect, topological Kerr and Faraday rotation, and the quantum anomalous Hall effect (AHE)[4].

Nonetheless many topologically protected modes apears on quantum mechanical system, Raghu and Haldane proposed nontirivial topological modes are rather a wave phenomenon than quantum effect by demonstrating optical analog of quantum Hall effect(QHE) with periodically arrange gyromagnetic rods [5, 2]. Many theoretical proofs has been proposed on this field[2, 7, 1].

In this research, we will verify the idea to break the TR symmetry on the mechanical graphene using coriolis force with non-inertial reference frame of a rotating system with actual device[3, 6]. As an experimental device, we introduce two devices. The first one is 1D spring-mass type chain in which masses are placed on the edge of a circle.

2 Formulation

2.1 1D mechanical lattice on inertial frame of reference

2.1.1 Approximated model

2.1.2 Exact model

We don't need to use exact model like fig because wavenumber propagates through tangential direction does not have measurable effect on overall dispersion relation.

$$-m\omega^2 u = k\langle$$

2.2 1D mechanical lattice on non-inertial reference frame

2.2.1 With coriolis force

2.2.2 With coriolis force and centrifugal force

2.3 2D mechanical graphene on inertial frame of reference

2.4 2D mechanical graphene on non-inertial reference frame

2.4.1 With coriolis force

2.4.2 With coriolis force and centrifugal force

3 Experiment

3.1 Experimental setup

contents

3.2 1 dimensional mechanical lattice

3.3 2 dimensional mechanical graphene

4 Result

5 Conculsion

6 Further research

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