Quantum Geometry and Nonlinear Electronic Transport in Kagome Bilayers

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In this paper, we investigate the quantum metric-induced nonlinear transport phenomena on bilayer Kagome lattice systems in the non-interacting limit in the tight-binding approach.
[1]

I. INTRODUCTION

- Background on the kagome lattice and physics.

- Nonlinear transport phenomena coming from the quantum metric

- Focus of the research: Nonlinear transport phenomena based on the quantum metric that could arise in bilayer magnetic kagome systems

- Research gap/ question: In nature, there are families of kagome materials with: 1) spin-orbit coupling 2) magnetism, including various magnetic orderings. The goal now is to shed light on quantum metric transport in these systems, and see if there is something new one can learn from it.

II. KAGOME MODELS

- What is the magnetic space group for the system? This has been mentioned in [2]. For the breathing kagome system, The magnetic space group is p3m1. The original system had C_3 symmetry, which is broken by the kagome distortion. To explain this, "3m" means that we have a three-fold rotation symmetry and mirror symmetry.

- Can we write a general TB model based on the knowledge of the MSG?

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To motivate our discussion, we start with a monolayer system. The goal is to understand how to systematically break symmetries and write down models that obey the symmetry constraints. This has been discussed in [3] First, we suppress all hoppings within the same sub-lattice. So, we have

$$\mathcal{H} = \begin{pmatrix} 0 & \phi_1 & \phi_2 \\ \phi_1^\star & 0 & \phi_3 \\ \phi_2^\star & \phi_3^\star & 0 \end{pmatrix} \tag{1}$$

III. NONLINEAR TRANSPORT FROM THE QUANTUM METRIC (BCP EFFECT)

IV. METHODOLOGY

Explanation of the numerical calculations being done and the simulation parameters

V. RESULTS

In this section, summarize the results pertaining to the trimerized model with broken C_3 symmetry

VI. DISCUSSION AND OUTLOOK

[1] E. Tang, J.-W. Mei, and X.-G. Wen, Phys. Rev. Lett. **106**, 236802 (2011).

[2] M. A. J. Herrera, S. N. Kempkes, M. B. De Paz, A. García-Etxarri, I. Swart, C. M. Smith, and D. Bercioux, Phys. Rev. B **105**, 085411 (2022).

[3] C. K. Geschner, A. Y. Chaou, V. Dwivedi, and P. W. Brouwer, On the band topology of the breathing kagome lattice (2024),

A. Other

4+5 pages, 3+1 figures.