Constructing lattice models for anyons in 1D

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Abstract

In two dimensions, anyons obey fractional statistics intermediate between fermions and bosons and are often described by a braid group. Braid-anyon exchange statistics can also be found in one dimension (1D). After briefly reviewing the properties of the paradigmatic 1D anyon-Hubbard model (AHM), in this talk, we will introduce two lattices models of anyons in 1D. First, we propose an effective swap model to describe the anyonic behaviour of impurities immersed in strongly-interacting Bose gases. It provides a new framework of engineering abelian braid anyons in spinor quantum gases [1]. Second, we go beyond the braid group statistics, and propose a concrete model to realize a new type of anyon, which is described by a triad group. It is found to indicate signs of approximate Haldane exclusion statistics. Our works offer new possibilities of engineering anyons in quantum simulation platforms [2].

References

[1] Sudipta Dhar*, Botao Wang*, Milena Horvath*, Amit Vashisht, Yi Zeng, Mikhail B. Zvonarev, Nathan Goldman, Yanliang Guo, Manuele Landini, and Hanns-Christoph Nägerl, arXiv:2412.21131.

[2] Sebastian Nagies, Botao Wang, A.C. Knapp, André Eckardt, and N. L. Harshman, SciPost Phys. **16**, 086 (2024).
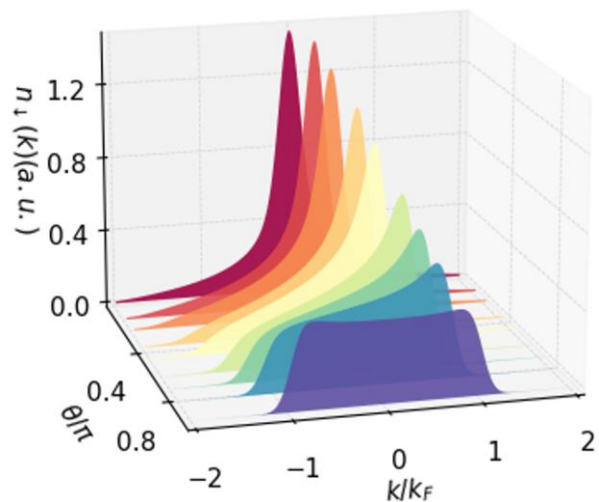
Figures

Figure 1: Quasi-momentum distribution of abelian anyons in one dimensional lattice.
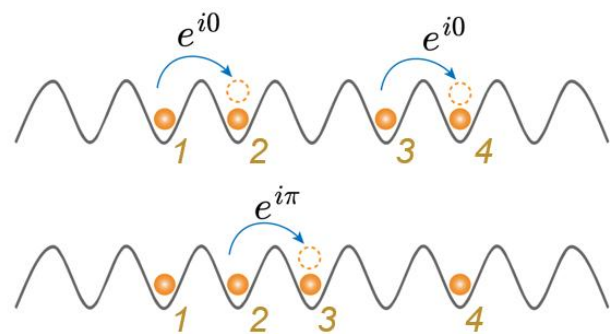

Figure 2: Sketch of some possible hopping processes in our lattice model for traid anyons.