

凝縮系物理学ゼミナール

Condensed Matter Seminar

Date: 13:30-15:00, Wednesday, 27 October 2021

Title: Nonreciprocal transport induced by homogeneous dissipation in open many-particle systems

Speaker: Kazuki Yamamoto (Condensed Matter Theory Group)

Abstract:

Nonreciprocal phenomena have been a long-standing problem in condensed matter physics and nonequilibrium statistical mechanics [1]. In open quantum systems, one common way to introduce rectification is to couple a system with two different baths at boundaries and use temperature gradients [2]. Such studies focus on inhomogeneous setups by boundary driving, in contrast, theory for rectification induced by homogeneous dissipation of nonequilibrium baths has not been established yet.

In this talk, we study how translationally invariant couplings of many-particle systems and nonequilibrium baths can be used to rectify particle currents, for which we consider minimal setups to realize bath-induced currents in nonequilibrium steady states of one-dimensional open fermionic systems [3]. We first analyze dissipative dynamics associated with nonreciprocal Lindblad operators and identify a class of them that are sufficient to acquire a nonreciprocal current. We show that unidirectional particle transport can in general occur when a Lindblad operator is reciprocal provided that the inversion symmetry and the time-reversal symmetry of the microscopic Hamiltonian are broken, e.g., in the presence of the Rashba spin-orbit coupling and the Zeeman magnetic field.

Reference:

[1] Y. Tokura, and N. Nagaosa, *Nat. Commun.* 9, 3740 (2018)

[2] V. Balachandran, G. Benenti, E. Pereira, G. Casati, and D. Poletti, *Phys. Rev. Lett.* 120, 200603 (2018).

[3] K. Yamamoto, Y. Ashida, and N. Kawakami, *Phys. Rev. Research* 2, 043343 (2020)