凝縮系物理学ゼミナール
Condensed Matter Theory Seminar
Date: 13:30-15:00, Wednesday, 9, April 2025

Title: Symplectic-Amoeba formulation of the non-Bloch band theory for one-dimensional two-band systems

Speaker: Mr. Shin Kaneshiro

Language: English

Abstract:

The non-Hermitian skin effect is a topological phenomenon that does not have counterparts in Hermitian systems, resulting in the condensation of bulk modes near the boundaries [1, 2]. Due to the exponential localization of bulk modes, boundary effects remain significant even in the thermodynamic limit. This makes conventional Bloch band theory inapplicable and hinders the accurate computation of the spectrum under the open boundary condition (OBC). In one-dimensional systems, the generalized Bloch band theory, called non-Bloch band theory, has been developed and enables us to access the OBC spectrum [1, 3]. However, the non-Bloch band theory for higher-dimensional systems remains nontrivial.

The Amoeba formulation addresses this problem by using the two-dimensional electrical potential analogy [4]. The spectral potential is obtained by regarding the eigenvalues in the complex plane as electrical charges on a two-dimensional plane. Using the generalized Szegö's limit theorem, the OBC spectral potential is reduced to an optimization of the Ronkin function, which is calculated with the modulated PBC spectrum. While the Amoeba formulation provides novel insights into non-Hermitian physics in higher dimensions [5, 6], challenges arise from the multiband nature and symmetry-protected degeneracies, even in one-dimensional cases.

In this work, we investigate one-dimensional two-band class AII systems, where Kramers pairs invalidate the above Amoeba formalism [7]. We find that these challenges can be overcome by optimizing the band-resolved Ronkin functions, which is achieved by extrapolating the total Ronkin function. Finally, we propose a modification to the generalized Szegö's limit theorem in class AII and numerically demonstrate that our approach correctly computes the potential and localization length.

References:

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