



量子物理学・ナノサイエンス第 75 回特別セミナー

Symmetry, Topology, Exact Many-Body Ground States, and Exact Many-body Excitations in Twisted Bilayer Graphene

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日程 : 12 月 21 日 (月) 10:00 -

場所 : Zoom*

概要

We have performed a thorough study of the many-body physics in twisted bilayer graphene (TBG) through a series of six works. First, we found useful approximations for the Hamiltonian and explained why the bands are flat over the whole Brillouin zone (not only around the Dirac points). Second, we found that, with an approximate particle-hole symmetry, the continuous model of TBG is anomalous, which means that it cannot be realized on lattices. These two properties lead to a projected Coulomb Hamiltonian that can only be written in momentum space. Then we found that the projected Coulomb Hamiltonian hosts a $U(4) \times U(4)$ symmetry in the chiral limit and a $U(4)$ symmetry otherwise, and explicitly derived the symmetry generators. Forth, with the help of symmetries, we can write down exact eigenstates of the projected Coulomb Hamiltonian at integer fillings, which are also ground states if the so-called “flat-metric-condition” is satisfied. These ground states are parent states of the valley-polarized states, valley-coherent states, and Chern states. Fifth, given the many-body symmetries and exact ground states, we can also derive the exact charge 1, 2, 0 excitations, with Goldstone modes included. Remarkably, through charge 2 excitations, we prove the absence of Cooper pairs in the project Coulomb Hamiltonian around integer fillings. Finally, we confirmed the analytical results using numerical exact diagonalization, which also suggests phase transitions to other ground states when $U(4)$ or $U(4) \times U(4)$ is significantly broken.

*本 ZOOM セミナーに参加されます場合には、事前に下記より登録を済ませてください。

<https://zoom.us/meeting/register/tJwofumtrzouG9SYrWQ8dmvwtK16qKqeIquE>

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