Kondo insulators – non-Hermitian properties and low-energy excitations

Although Kondo insulators are known for more than 50 years, recent experimental observations and theoretical calculations have revealed many things that we do not understand in this class of strongly correlated insulators. Initially thought of being similar to noninteracting band insulators, recent experiments observed quantum oscillations in magnetic fields, an unusual metallic state in very strong magnetic fields, and an anomalous thermal conductivity in the charge-insulating state[1-4]. These experiments cannot be explained by a usual band insulator picture and have sparked renewed interest in Kondo insulators.

Motivated by these experiments, I will show some recent results demonstrating that Kondo insulators are quite different from band insulators. In the first part, I will analyze band touchings in the single-particle Green's function due to the non-Hermiticity induced by strong correlations. In particular, I will focus on non-Hermitian properties and exceptional points appearing in a topological Kondo insulator at finite temperatures and show how spectral functions and spin-expectation values are affected by them.
In the second part, I will present numerically exact solutions of the one-dimensional Kondo insulator at finite temperatures. I will show one- and two-particle spectral functions and compare them to thermodynamical properties. Finally, I will calculate the electric and thermal conductivity and analyze the validness of the Wiedemann Franz law at finite temperatures in these systems.

[1] Tan et al. Science Vol. 349, pp. 287-290
[2] Xiang et al. Science 05 Oct 2018: Vol. 362, Issue 6410, pp. 65-69
[3] Sato et al. Nature Physics volume 15, pages 954–959(2019)
[4] Sato et al. arXiv:2103.13718
[5] Yoshida et al. Progress of Theoretical and Experimental Physics 2020 (12), 12A109
[6] Michishita et al. Physical Review B 101 (8), 085122
[7] Yoshida et al. Physical Review B 98 (3), 035141