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Joule meets van der Waals: Non-contact Energy Dissipation on a Topological Insulator Surface

Abstract: Energy dissipation between macroscopic bodies in motion can occur even with a nanometer-scale gap between them. Such small amounts of energy can be measured as nanomechanical energy dissipation of an oscillating cantilever like a pendulum when it is brought nearby a surface. Importantly, not only the amount of dissipation can be measured, but also the nature of dissipation and quantum effects in dissipation are revealed. Here, we study the model topological insulator Bi_2Te_3. Owing to the topologically protected surface states, Joule-type dissipation is very small or absent on the Bi_2Te_3 surface. Instead, van der Waals dissipation was found to be the dominant mechanism and was enhanced following population of image potential states. Applying a magnetic field breaks down the topological protection of the surface state, restoring the Joule dissipation. I will present pendulum AFM as a powerful, non-invasive tool for topological surface analysis, with the capability to address quantum effects in non-contact dissipation.

Bio: Dilek Yildiz is a postdoctoral researcher at the National Institute of Standards and Technology (NIST). She received her BSc and MSc degrees from Istanbul Technical University. Dilek continued her SPM career at the University of Basel, where she studied non-contact energy dissipation of layered materials for her PhD. She worked at ETH Zurich and Harvard University before joining Joe Stroscio's team at NIST in 2021. Currently, she is involved in the development of an ultra-low temperature scanning probe system.