中央大學物理學系

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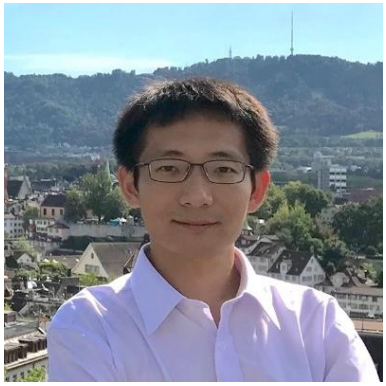

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Lossless and Monostructural Spintronics - A Great Promise by Magnetic Topological Insulators

Date: 2024/06/18 (Tue)
Venue: S4-625
Time: 14:00-15:00

Abstract:
Spintronics is an essential upgradation of electronics where the quantum spin of electrons becomes a central quantity of interest. A prevailing pursuit of spintronics has been effective control of magnetism via electrical means, which can be realized in a heterostructure composed of a magnet and a non-magnetic driver operated by electric currents. This archetypal setup, however, suffers from two fundamental problems: 1) The transfer of spin angular momenta is greatly inhibited by the interface; 2) The input power is mostly dissipated through Joule heating, rendering the overall efficiency surprisingly low. The advent of intrinsic magnetic topological insulators (iMTIs) opened a unique physical platform to fully address the above issues. Thanks to the intertwined topological electrons and magnetic ordering, an iMTI driven by electric fields can generate non-equilibrium spins on its own, which in turn drives itself without the aid of other materials. Such a monostructural setup can function as an electrical actuator and a magnetic oscillator simultaneously, thus obviating the undesirable interface in heterostructures. Moreover, due to the insulating nature of iMTIs, the spin generation and transfer processes do not rely on Ohm's currents but are instead enabled by the "adiabatic currents" arising from the topological properties of electrons. Because adiabatic currents do not incur Joule heating, they are able to convert 100% of the input electric power into magnetic dynamics, marking a transformative boost of operational efficiency compared to established approaches. In this presentation, I will walk you through the intriguing physics underlying the compelling functionalities of monostructural spintronics based on iMTIs, which heralds a new paradigm featuring lossless power conversion in the absence of interfaces, heterostructures, and other common complications.