Center for Artificial Low D Electronic Systems

# 2025 IBS-CALDES Seminar

- ✓ **Date & Time** 04:00 PM , February 11(Tue), 2025
- ✓ **Venue:** Room #104, IBS POSTECH campus bldg.
- ✓ **Speaker & Title**

  04:00PM Prof. Jong Eun HAN (Department of Physics, State University of New York at Buffalo)

  "Quantum Resistive Switching through Disorder and Correlation"

Organized by: Prof. Han Woong YEOM (yeom@postech.re.kr, 054-260-9000)

- **04:00PM~**

# "Quantum Resistive Switching through Disorder and Correlation"

Jong E. HAN
Department of Physics, State University of New York at Buffalo

Insulator-to-metal transition under an electric field, known as resistive switching, remains unresolved. The diverse nature of this nonequilibrium transition has defied a reliable theoretical description even at the most basic level, whether the transition is of thermal or quantum nature. In this informal talk, I will present preliminary results where we considered the interplay of disorder, a key ingredient in the subject, with the electron correlation. We model the disorder by the coherent potential approximation (CPA) within the DMFT scheme. The disorder strongly affects the low energy correlated states, and even a weak disorder drastically changes the ingap spectrum into the so-called V-shaped DOS. This disorder-induced ingap physics on the single-band Hubbard model, which has been considered an unlikely model for resistive switching, supports an insulator-to-metal transition (IMT) with a strongly discontinuous transition at electric field much smaller than the crossover IMT fields without the disorder. The ingap states mediate strong nonequilibrium charge excitations across the Mott gap, sometimes as strong as to induce a population inversion between the Mott bands. We also investigate the pitfalls of perturbation approximations.

This model presents an IMT mechanism without a thermal transition. The dependence of the IMT with the temperature and dephasing rate suggests quantum mechanical origin. The nonequilibrium metallic state after the IMT has an extremely long decay time back to the insulating ground state and persists as a supercooled metal at zero field and zero temperature. We will discuss this many-body and disorder-driven non-volatile metal (presumably a doublon-holon liquid) and its possible experimental implications.