Hội thảo: "Vật lý Kondo và các phương pháp nghiên cứu liên quan" - Phần 1

Workshop: "Kondo Physics and Related Research Methods" - Part 1

Institute of Physics, VAST. Thursday, May 07, 2026

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Talk 1 (9am – 10am):

Speaker: Assos. Prof. Dr. Giang Huong Bach

Faculty of Physics, VNU University of Science, Hanoi, Vietnam (gbach@hus.edu.vn)

Title: Dynamical Mean-Field Theory of Correlation Effects in Dynamic Hubbard Models

Abstract: We review a systematic study of dynamical correlation effects in several versions of the dynamic Hubbard model using Dynamical Mean-Field Theory (DMFT). Unlike the conventional Hubbard Model, dynamic Hubbard models incorporate additional internal degrees of freedom—such as auxiliary bosonic modes or orbital relaxation—that render the on-site interaction effectively changeable. Capturing these effects requires non-perturbative approaches capable of treating strong correlations and local quantum fluctuations on equal footing.

Within DMFT, we analyze multiple formulations of the dynamic Hubbard model, including boson-assisted interactions, occupation-dependent coupling schemes or two-band Hubbard model with nonlocal inter-orbital hopping. By employing single/multi-impurity Anderson model whose Kondo effect is the low-energy, strong-coupling manifestation, we compute spectral functions, quasiparticle weights, and thermodynamic quantities across a wide range of interaction strengths, bosonic frequencies, and carrier densities. Our results reveal how dynamical screening and correlation-induced renormalization modify the metal–insulator transition. The interplay between electron-boson coupling and strong correlations is shown to generate asymmetries between electron- and hole-doped systems, offering insights relevant to unconventional superconductivity and correlated materials with orbital flexibility.

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Talk 2 (10am – 11am):

Speaker: Dr. Hoa Nghiem

Phenikaa Institute for Advanced Study, Phenikaa University, Hanoi, Vietnam

Title: Numerical Renormalization Group Method for Quantum Impurity Systems: From Fundamentals to Recent Developments

Abstract:

Quantum impurity systems play a central role in describing strongly correlated phenomena and form the foundation of Dynamical Mean-Field Theory (DMFT), where a lattice system is mapped onto an impurity model via the self-energy $\Sigma(\omega)$. In both equilibrium and nonequilibrium DMFT, the solution of the impurity problem also provides the two-time correlation function $\Lambda(t, t')$, enabling a direct description of transient dynamics and time-resolved observables. Examples include Kondo systems, transport through quantum dots at intermediate times and in nonequilibrium steady states, as well as pump–probe photoemission spectroscopy.

These requirements call for an impurity solver capable of covering both low and high energy scales and accessing real-time dynamics. This lecture introduces the foundations of Wilson's Numerical Renormalization Group (NRG), from the discretization of the conduction electron spectrum and its mapping onto a semi-infinite chain, to iterative diagonalization and many-body spectral analysis. Recent developments such as the Complete Basis Set and the Full Density Matrix approach significantly improve the accuracy of NRG at all temperatures. Finally, the lecture explores the combination of the equation of motion with the self-energy formalism to extend the applicability of NRG to more complex nonequilibrium and time-dependent problems.

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Morning discussion 30 minutes

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Lunch break (11.30am – 1pm)

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Talk 3 (1pm – 2pm):

Speaker: Dr. Hung T. Dang

Faculty of Materials Science and Engineering, Phenikaa University, Hanoi, Vietnam

Title: The pseudogap Anderson model on graphene lattice

Abstract:
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A correlated impurity embedded in a host of noninteracting fermions is a fundamental long-standing problem in the field of strongly-correlated systems. For a metallic host, the well-known physics is the Kondo effect, in which the local moment of the impurity is screened by electrons of the host. However, if the host belongs to certain classes of semimetals such as graphene, where the energy dispersion is linear and vanishes at the charge neutrality point, the Kondo effect may only exist at the mixed valency. Thus there is a quantum phase transition from the free impurity local moment to the Kondo screening phase, i.e. the pseudogap Kondo problem. In this talk, I will present the full phase diagram of the pseudogap Anderson model with graphene as the host. I will show that, in this phase diagram, there is a linear relation between the electron correlation strength and the impurity energy level at criticality and the nonlinear behavior of the phase boundary with respect to the hybridization between the graphene sheet and the impurity. I will also point out the important role of the impurity occupancy, which can be used to interpret the behaviors of the phase diagram. Finally, I will discuss the scaling behavior at the critical point, which may reflect the "upper critical dimension" of Kondo physics on graphene.

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Talk 4 (2pm – 3pm):

Speaker: Dr. Thanh Nguyen

Institute of Physics, Vietnam Academy of Science and Technology, Hanoi, Vietnam

Title: Thermoelectric transport in a single-site charge Kondo circuit

Abstract : A paradigmatic phenomenon that captures the interplay between resonant scattering and strong correlations is the Kondo effect, in which a localized spin couples to conduction electrons. While it is traditionally associated with spin degrees of freedom of a quantum impurity, a variety of unconventional Kondo phenomena have been identified in diverse platforms. Among them, the charge Kondo effect arises from a pseudospin defined by charge quantization. Its theoretical framework was established in the 1990s by Flensberg, Matveev, and Furusaki. In 2015, the first experimental realization-based on engineered quantum Hall edge states-demonstrated a controllable charge Kondo device, enabling access to multi-channel Kondo regimes.

In this talk, I will present our recent results on thermoelectric transport in a single-site charge Kondo circuit. In particular, we derive the universal temperature scaling of the thermoelectric coefficients perturbatively near the non-Fermi-liquid strong-coupling fixed point using Abelian bosonization.
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Afternoon discussion: 30 minutes and more
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