PCS NEWSLETTER

April 2022

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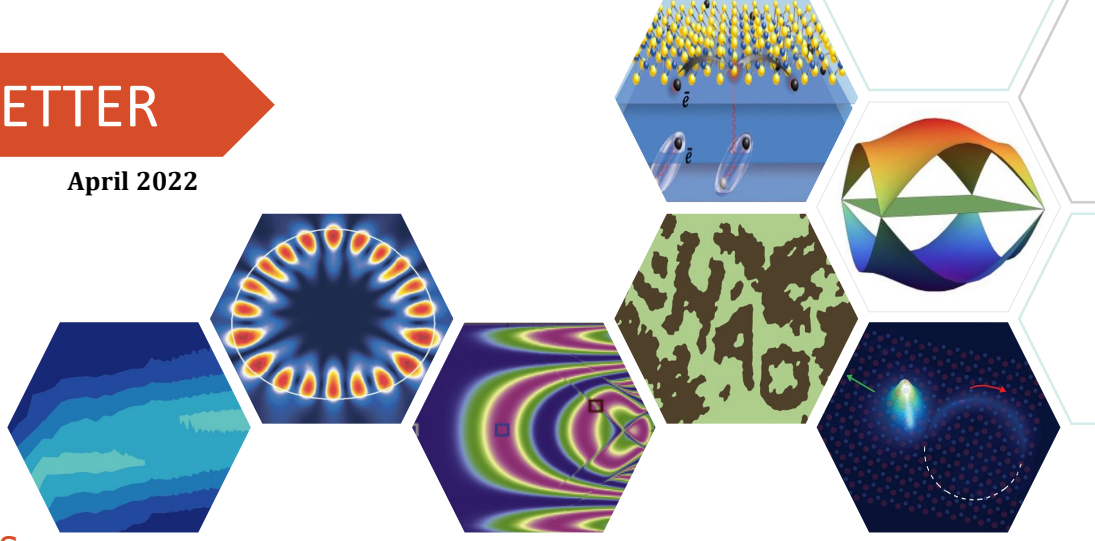


PCS IBS Seminars

"Understanding quantum chaos through adiabatic transformations"
by Anatoli Polkovnikov, University of Boston, USA (Feb. 24)

"Avalanches and many-body resonances in many-body localized systems"
by Alan Morningstar, Princeton University, USA (Mar. 3)

"Thermodynamics of quasi-probability distributions for open quantum harmonic oscillators"
by Jong-Min Park, Korea Institute for Advanced Study, Korea (Mar. 8)

"Orbital-selective Mott phase and non-Fermi liquid state in $FePS_3$"
by Minsung Kim, Ulsan National Institute of Science and Technology, Korea (Mar. 10)

"Ultra-deep optical cooling of nuclear spins in semiconductor structures"
by Kirill Kavokin, Ioffe Institute & St. Petersburg State University, Russia (Mar. 17)

"Kekule spin-orbit dimer phase and triplon dynamics"
by Gibaik Sim, Technical University of Munich, Germany (Mar. 22)

"Topological aspects of a multi-partite non-Hermitian Su-Schrieffer-Heeger model"
by Ritu Nehra, Raman Research Institute, India (Mar. 29)

"Bilayer phononic and photonic graphene: A new playground for twistronics"
by Yun Jing, Penn state university, USA (Mar. 31)

You can find more seminars on ***this page***.

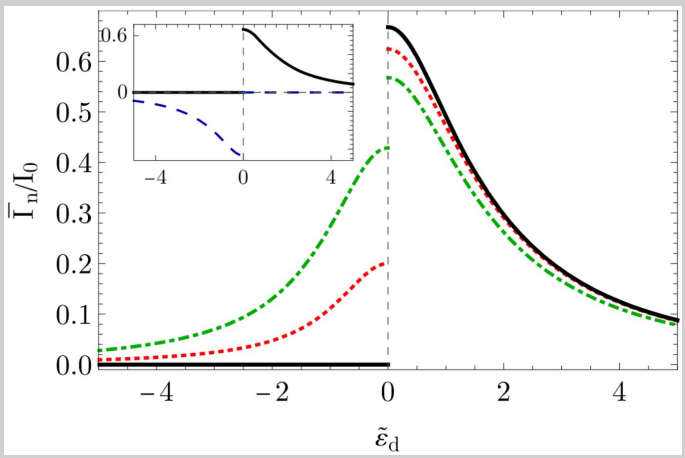
New research results

Nanomechanics driven by the superconducting proximity effect

O M Bahrova, S I Kulinich, L Y Gorelik, R I Shekhter and H C Park

New J. Phys. 24, 033008

The authors consider a nanoelectromechanical weak link composed of a carbon nanotube suspended above a trench in a normal metal electrode and positioned in a gap between two superconducting leads. They show that, in such a device under bias voltage between normal and superconducting electrodes, self-sustaining bending vibrations can emerge. The occurrence of this effect crucially depends on the direction of the bias voltage and the relative nanotube energy. The nanotube vibrations strongly affect its dc current, leading to a transistor/diode-like behavior. It gives an opportunity to probe mechanical instabilities in the device experimentally by measuring electric current.



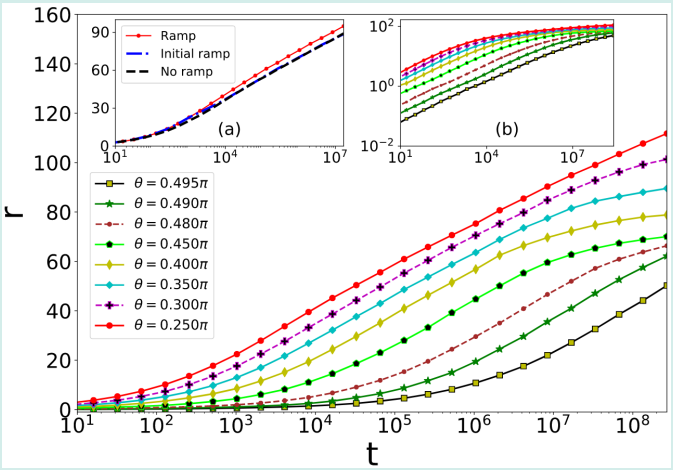
New research results

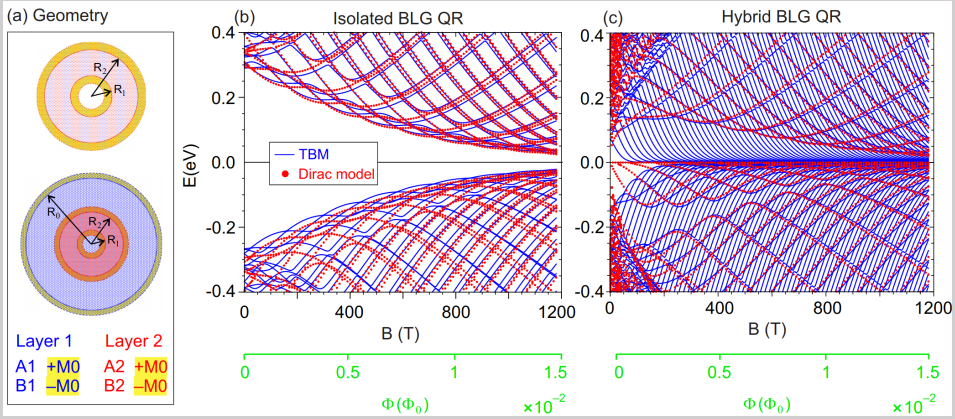
Thermoelectrics of a two-channel charge Kondo circuit: Role of electron-electron interactions in a quantum point contact

A. V. Parafilo, T. K. T. Nguyen, and M. N. Kiselev

Phys. Rev. B Letters 105, L121405 (arXiv:2107.09872)

This work investigates the effects of electron-electron interaction in a quantum impurity model. More precisely, the two-channel "charge" Kondo problem that was recently realized in a hybrid metal-semiconductor single-electron transistor is considered. The system consists of a large quantum dot in the weak Coulomb blockade regime strongly coupled to an electron reservoir via single-mode quantum point contact. The authors show that the interaction in the spin sector may drive the system away from the unstable non-Fermi-liquid fixed point to the stable Fermi-liquid regime. Non-Fermi-liquid to Fermi-liquid crossover can be detected through the different low-temperature scaling behavior of the Seebeck coefficient.





Isolated and hybrid bilayer graphene quantum rings

M. Mirzakhani, D. R. da Costa, and F. M. Peeters

Phys. Rev. B 105, 115430 (arXiv:2106.00947)

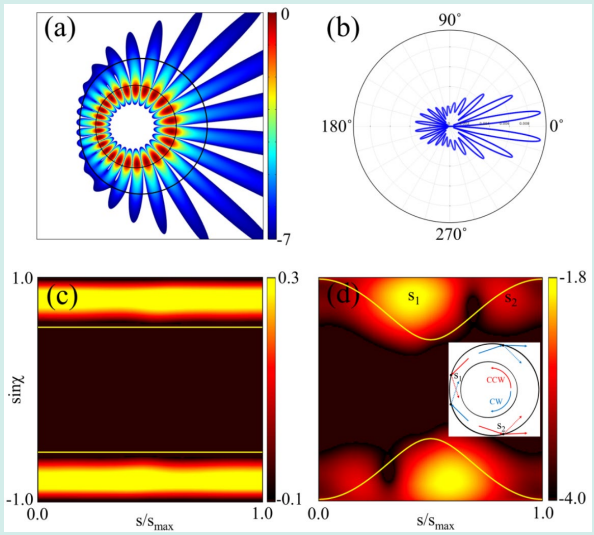
In this work, the authors investigate electronic properties of two types of bilayer graphene (BLG) quantum ring (QR) geometries: an isolated BLG QR and a monolayer graphene (MLG) with a QR put on top of an infinite graphene sheet (hybrid BLG QR). In the case of isolated BLG QR, they observe a sizable and magnetically tunable band gap. For the hybrid one, its energy levels are tunable from MLG dot to isolated BLG QR and to MLG Landau energy levels as magnetic field varies.

Double-layered transformation cavities: Crossover between local and global transformations

Jung-Wan Ryu

Phys. Rev. A 105, 033523 (arXiv:2112.08661)

The authors study the resonant modes in double-layer transformation cavities consisting of inner and outer layer boundaries where the mode intensity is mainly located inside the inner layer. This is an intermediate design between a transformation cavity and a cavity in a fully transformed space of transformation optics. They demonstrate the crossover between these two extremes as the outer layer of the cavity varies and also explore the properties of the resonant modes in the cavity. While the near-field patterns of the resonant modes do not change as the outer layer becomes larger, the Q-factors approach those of a cavity in the fully transformed space of transformation optics, and the far-field patterns are modified.



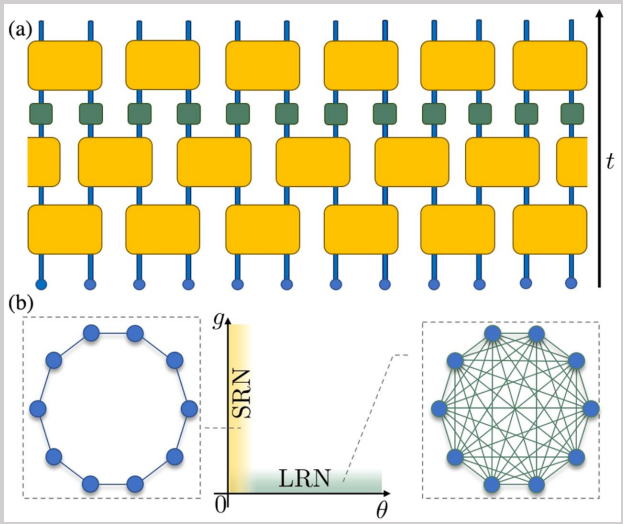
New research results

Lyapunov Spectrum Scaling for Classical Many-Body Dynamics Close to Integrability

Merab Malishava and Sergej Flach

Phys. Rev. Lett. 128, 134102 (arXiv:2109.01361)

The authors propose a novel framework to characterize the thermalization of many-body dynamical systems close to integrable limits using the scaling properties of the full Lyapunov spectrum. The most frequently used methods to investigate thermalization are related to tests of ergodicity of chosen observables. Consequently, the results might be affected by the choice. This analysis is independent of the choice of observables and allows for the identification and diagnostics of two fundamentally distinct long-range and short-range integrable limits which stem from the type of nonintegrable perturbations. The framework is applicable to a wide range of physical models which makes it a powerful tool for the description of weakly nonintegrable dynamics.



Puzzle of the month

March puzzle answer:

It is not. Mary has a winning probability of 3/4, and Paul has only a chance of 1/4 to win. Indeed, Paul only wins if the first tossing is a T, and the second one a T as well. That makes a probability of 1/4. In all other cases Mary wins. Why? In an infinite tossing sequence both segments TT and HT have the same probability to occur. So they both have an average distance L between their own repetitions. But there is a correlation. HT events are more likely to be followed by a TT before the average distance L/2 is reached. Since the game consists of choosing an arbitrary starting point in the infinite sequence, HT wins. What if Mary chooses TH instead? Well then the game turns fair. Both have to wait until a T is tossed. After that it is either Paul or Mary, with equal probabilities.

The correct answer came from Ihor Vakulchyk. Congratulations!

Puzzle of the month:

Paul and Mary play again the game with a fair coin - both heads (H) and tails (T) have same probability 1/2. They again start flipping.

Paul chooses the sequence TTT. Mary chooses HTT. What is the probability that Mary wins?

Paul chooses HHT. Mary chooses THH. Who wins, and with what probability?

Paul chooses HTH. Mary chooses HHT. Who wins, and with what probability?

Send your solution to eun@ibs.re.kr

The winner will be announced in the next issue.