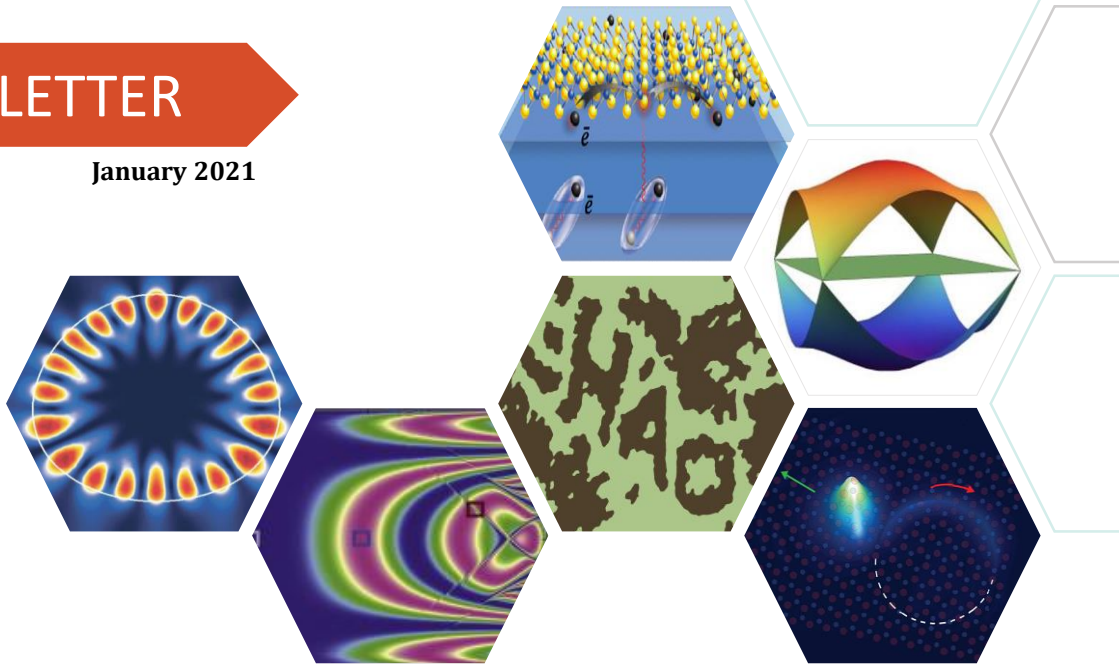
PCS NEWSLETTER

January 2021

Edit: Sungjong Woo
Design: Gileun Lee



New members

The research interest of **Dr. Dominik Šafránek** has been focused on understanding the concept of entropy, especially in quantum systems, concept of time, and the meaning of the second law of thermodynamics. He also studies quantum metrology, which is a science of using small systems exhibiting quantum behavior in order to construct extremely sensitive measurement devices such as a gravitational wave detector.

Dr. Varinder Singh works on the broad field of quantum thermodynamics especially in the research area of optimization of quantum thermal machines. He implements theoretical tools from quantum optics, open quantum systems and other finite-time optimization techniques for studying the optimal performance of energy conversion devices.

Awards

제2020-S026호

UST 과학기술연합대학원대학교 UNIVERSITY OF SCIENCE & TECHNOLOGY

표창장

2020년 UST 연구논문상 논문부문 우수상
2020 UST Research Paper Award Paper Field Excellence Award

박사과정 Ihor Vakulchyk
Ph.D. Program Ihor Vakulchyk

기초과학연구원 기초과학
Institute for Basic Science
Basic Science

위 수상자는 활발한 연구활동으로 논문성과가 우수하여
학교와 과학기술의 발전에 기여한 바가 크므로 이 상장을 수여합니다.
In recognition of the contribution to the university and the progress of science and technology through the outstanding research achievements, hereby confers Excellence Award of Paper Field.

2020년 12월 17일
December 17, 2020

과학기술연합대학원대학교 총장 김 이 환
President of University of Science & Technology
Ieehwan Kim

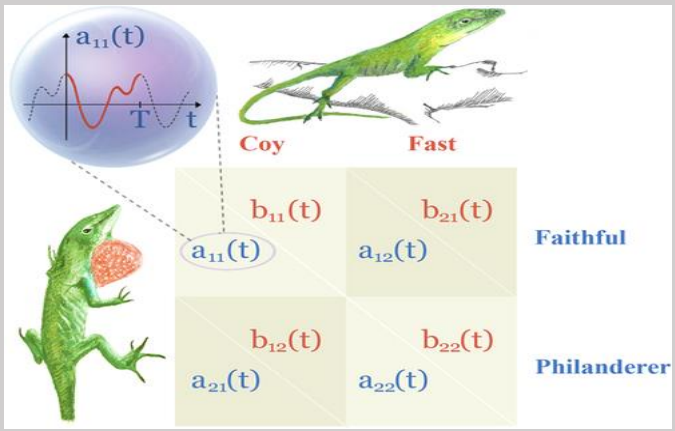
Congratulations! **Ihor Vakulchyk**, one of the Ph.D students of PCS, has won the UST research paper excellence award.

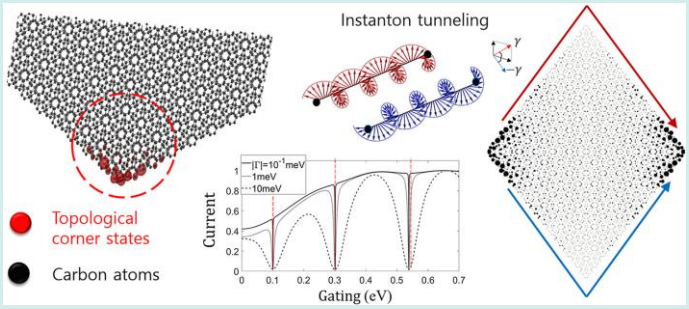
New research results

Quasi-stationary states of game-driven systems: A dynamical approach

Chaos **30**, 123145 (https://arxiv.org/abs/2006.10017), Sergey Denisov, Olga Vershinina, Juzar Thingna, Peter Hänggi, and Mikhail Ivanchenko

The authors use a zero-sum game to model the behavior of two competing agents whose populations evolve under a Moran process. They introduce a time-periodic pay-off between the agents that mimic seasonal variations and find that seasonal changes can lead to the population of the species skimming close to extinction periodically. Using their evolutionary game theory model, this research for the first time explore the role of seasonal variations and stochasticity on population cycling.





Higher-Order Topological Corner State Tunneling in Twisted Bilayer Graphene

J. Carbon 2020.12.037 (https://arxiv.org/abs/2006.01111), M. J. Park, S. Jeon, S. Lee, H. C. Park, Y. Kim

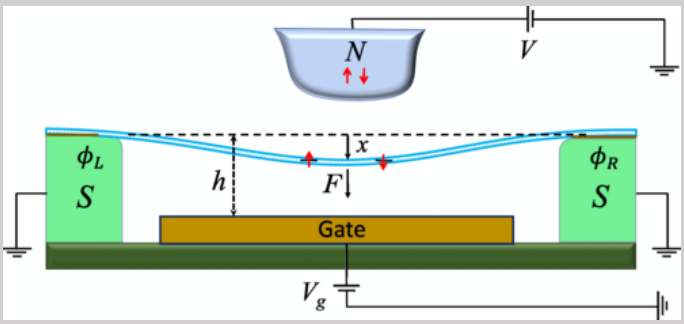
Topological insulators hosts metallic states at the interface against topologically-trivial insulators. Recently, there have been numerous studies on topological phases of higher-order topological insulators (HOTI) as interface states. The authors suggest a way to measure the experimental signatures of the HOTI phases from the view point of tunneling on a twisted bilayer graphene. The main discovery of this research is a new type of the instanton tunneling effect.

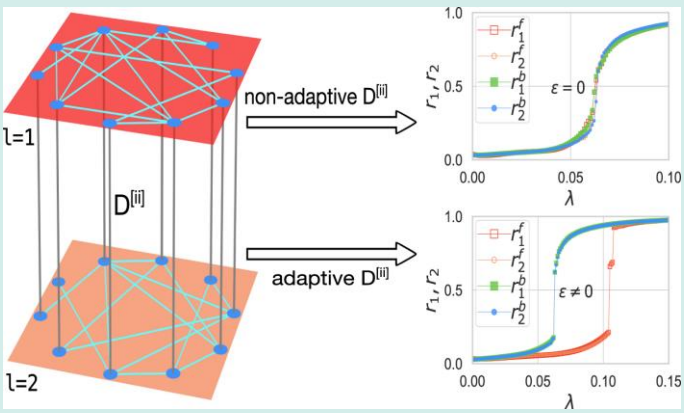
Nanomechanics driven by Andreev tunneling

Phys. Rev. B **102**, 235402 (https://arxiv.org/abs/2009.02679)

A. V. Parafilo, L. Y. Gorelik, M. V. Fistul, H. C. Park, and R. I. Shekhter

Nanoelectromechanical devices made of nanoscale resonators and electrons are used as ultrasensitive mass and force detectors. The authors have discovered a novel fundamental mechanism of electromagnetically-induced mechanical instability, which is based on actions of coherent and incoherent quantum processes of electronic subsystems. The precise control of a Josephson phase difference proposes a device for an achievement of SQUID (Superconducting Quantum Interference Devices) sensitivity to the external magnetic field.





Interlayer Hebbian Plasticity Induces First-Order Transition in Multiplex Networks

New J. Phys. **22**, 122001 (https://arxiv.org/abs/2010.09424)

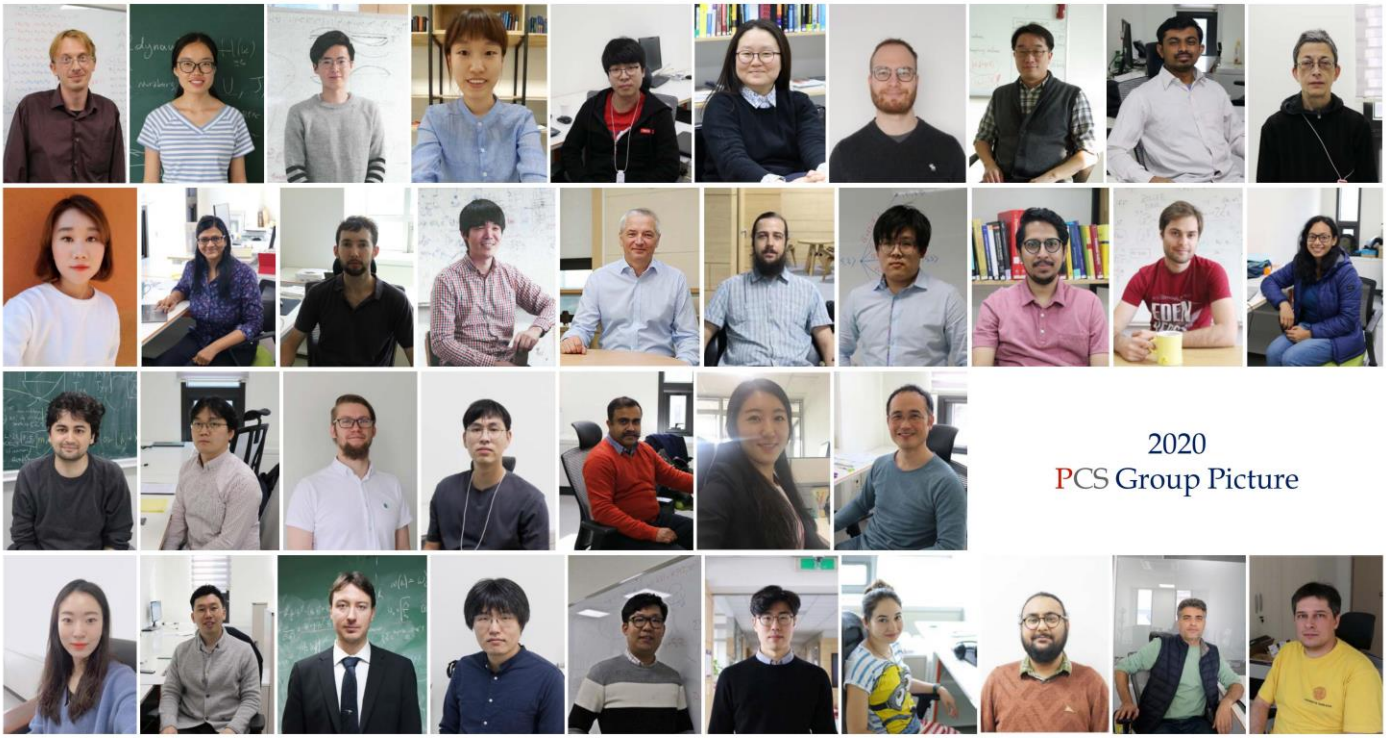
Ajay Deep Kachhvah, Xiangfeng Dai, Stefano Boccaletti, Sarika Jalan

Cells that fire together wire together. Applying this Hebbian theory to evolve the inter-layer connections, the authors have discovered that first-order transition to synchronization, popularly known as explosive synchronization, naturally arises in multilayer networks.

Puzzle of the month

$$\left[\sqrt{2021+4\sqrt{2021+4\sqrt{2021+4\sqrt{\ldots}}}}\right]\times\left[\sqrt{2021-4\sqrt{2021-4\sqrt{2021-4\sqrt{\ldots}}}}\right]=???$$

The answer will be in the next issue. ☺



We welcome 2021!