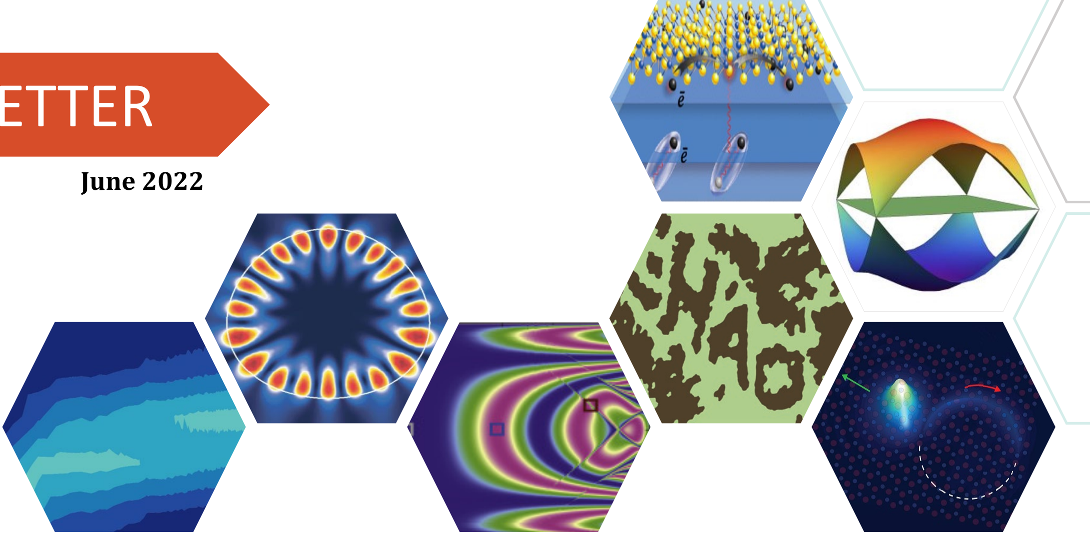
PCS NEWSLETTER

June 2022

Edit: Sungjong Woo
Design: Gileun Lee



News

We published our new PCS Scientific Reports 2019-2021.
PCS will run the third Scientific Advisory Board Meeting, June 16 – 17, 2022 in hybrid mode..

PCS Workshops and Meetings

PCS will run and host the International Workshop Condensed Matter Solitons June 29 – July 1, 2022 in zoom mode.

PCS IBS Seminars

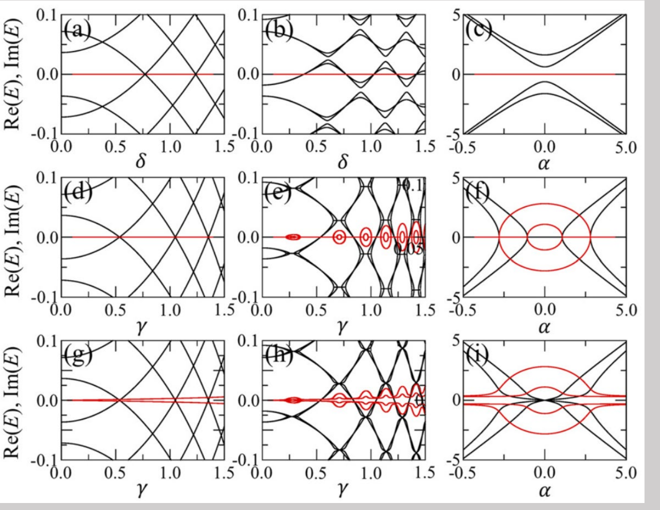
"The usefulness of quantum concepts in soft matter: quasiparticles, flat bands, and exotic topology in hydrodynamic matter"
by Tsvi Tlusty, Ulsan National Institute of Science and Technology, Korea (May 3)
"Classical physics and blackbody radiation"
by Giuliano Benenti, University of Insubria, Italy (May 17)
"Realization of Fractonic Quantum Phases in Frustrated Magnets"
by Yong Baek Kim, University of Toronto, Canada (May 18)
"Multiple Gravitons and spectral sum rules in Fractional Quantum Hall systems"
by Dung Xuan Nguyen, Brown University, USA (May 19)
"Discrete and continuous dissipative time crystals in an atom-cavity system"
by Andreas Hemmerich, University of Hamburg, Germany (May 24)
"Physical and mathematical relations between quantum metric and topology of Chern insulators"
by Tomoki Ozawa, Tohoku University, Japan (May 31)
"Discrete and continuous dissipative time crystals in an atom-cavity system"
by Andreas Hemmerich, University of Hamburg, Germany (Apr. 28)

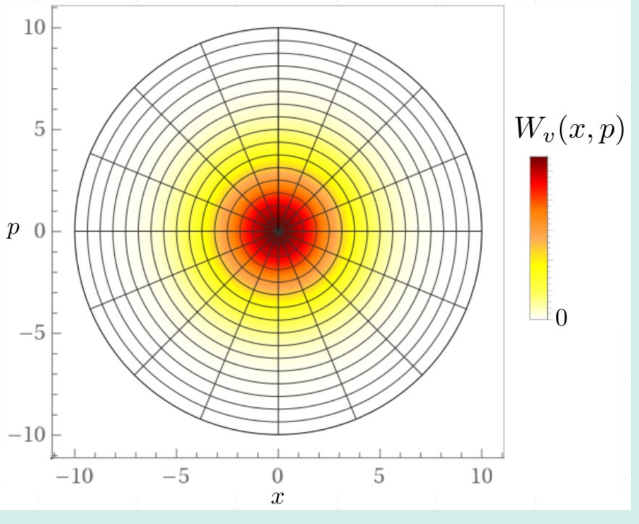
You can find more seminars on ***this page***.

New research results

Mesoscopic Möbius ladder lattices as non-Hermitian model systems
Jung-Wan Ryu and Martina Hentschel
J. Phys. A: Math. Theor. **55**, 224008 (arXiv:2205.01641)

While classic quantum chaos is based on nonlinear physics within Hermitian quantum mechanics, non-Hermitian models have enhanced the field in recent years. On the other hand, low-dimensional effective matrix models have proven to be a powerful tool in accessing the physical properties of such a system in a semiquantitative manner. The authors focus on two realizations of non-Hermitian physics in mesoscopic systems, spiral optical microcavities with asymmetric scattering and *PT*-symmetric ladder lattices with Möbius geometry. The emergent phenomena in non-Hermitian systems are well explained using an effective description with 2 × 2 matrices.

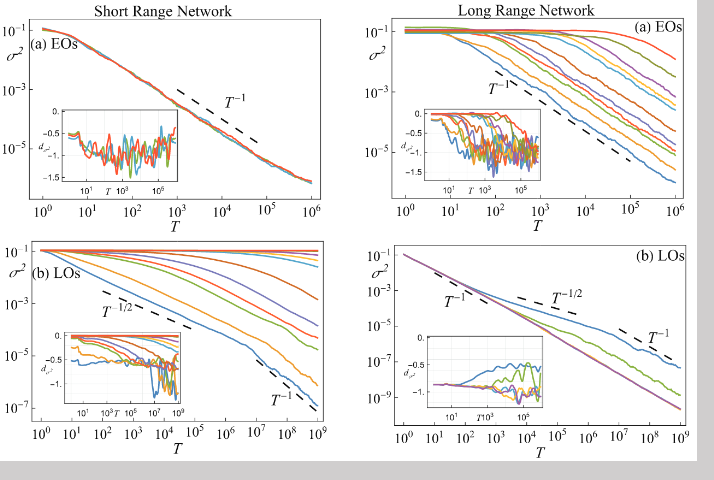




Cooling of nanomechanical vibrations by Andreev injection
O. M. Bahrova, S. I. Kulinich, L. Y. Gorelik, R. I. Shekhter, and H. C. Park
Low Temp. Phys. 48, 476 (arXiv:2202.08009)

The authors consider a nanoelectromechanical weak link composed of a carbon nanotube suspended between two normal electrodes in a gap between two superconducting leads. The nanotube is treated as a movable single-level quantum dot in which the position-dependent superconducting order parameter is induced due to the Cooper pair tunneling. It was found that at a given direction of the applied voltage between the electrodes, the stationary state of the mechanical subsystem has a Boltzmann form (see the figure) with an effective temperature which depends on the parameters of the device. As this takes place, the effective temperature can reach significantly small values (cooling effect). It is also demonstrated that nanotube fluctuations strongly affect the dc current through the system.

Thermalization dynamics of macroscopic weakly nonintegrable maps
Merab Malishava and Sergej Flach
Chaos 32, 063113 (arXiv:2203.10461)



The authors study thermalization of macroscopic systems in proximity to integrable limits. they use a discrete-time unitary map model which allows to simulate the large time- and lengthscale dynamics in an efficient way, free from errors compared to time-continuous Hamiltonian dynamics. In order to study thermalization, one typically tests the ergodic hypothesis with chosen observables. They show that this choice is ambiguous as different observables may display different thermalization dynamics. They then develop a systematic approach to choosing the right observables and extract corresponding ergodization timescales. For comparison they compute the the Lyapunov time, finding that the relation of two timescales depends strongly on the nature of the nonintegrable perturbation. In weakly nonlinear systems the ergodization timescale can be determined from the Lyapunov time, whereas in weakly coupled systems it is orders of magnitude larger. They further find that in weakly coupled regime the chaotic dynamics is local while weakly nonlinear regime show extended dynamics.

Puzzle of the month

Our second call for answers was successful. The first one came from Moon Jip Park, followed by Ihor Vakulchyk's one. Congratulations to both! And Moon Jip performed a much more detailed study than asked for, which we want to share with all of our readers:
Answer to the case (i): Mary wins with P = 7/8.
Answer to the case (ii): Mary wins with P = 3/4.
Answer to the case (iii): Mary wins with P = 2/3.

Probability table for Paul's victory (Mary's victory= 1- Paul's victory)

Mary \ Paul	HHH	THH	HTH	TTH	HHT	THT	HTT	TTT
HHH	1/2	1/8	4/10	3/10	1/2	0.4169	2/5	1/2
THH	7/8	1/2	1/2	1/3	3/4	1/2	1/2	3/5
HTH	3/5	1/2	1/2	3/8	**1/3 (iii)**	1/2	1/2	0.5832
TTH	7/10	2/3	5/8	1/2	1/2	2/3	1/4	1/2
HHT	1/2	**1/4 (ii)**	2/3	1/2	1/2	5/8	2/3	7/10
THT	0.5832	1/2	1/2	1/3	3/8	1/2	1/2	3/5
HTT	6/10	1/2	1/2	3/4	1/3	1/2	1/2	7/8
TTT	1/2	4/10	0.4170	1/2	3/10	2/5	**1/8 (i)**	1/2

Puzzle of the month:
Choose a prime number P > 3. Square it and subtract 1: Q=P*P-1. Is Q divisible by 24? Why?

Send your solution to eun@ibs.re.kr
The winner will be announced in the next issue.