PCS NEWSLETTER



News members



Jiwoo Seo has joined PCS as an undergraduate internship student for two months in the team of Quantum Chaos in Many-Body Systems. He is currently attending Kyung-Hee University. His research topic will focus on numerical studies of manybody localization based on large-scale ED techniques.

News

PCS hosted the third Scientific Advisory Board Meeting, June 16 – 17, 2022 in hybrid mode. Our members have presented talks and posters about the current research progress and future prospect and got fruitful critics and advices from the board committee members.

PCS IBS Seminars

- "Catalysis in Action via Elementary Thermal Operations" by Jeongrak Son, Nanyang Technology University, Singapore (June 9)
- "Coexistence of localization and transport in many-body two-dimensional Aubry-André models" by Claudio Castelnovo, University of Cambridge, UK (June 9)
- "An Exact Map Between the TBG (and multilayers) and Topological Heavy Fermions" by Andrei Bernevig, Princeton University, USA (June 14)
- "Giant photovoltaic effect induced by wall-to-wall shift currents in semiconducting WS2 nanotubes" by Jeongwoo Kim, Incheon National University, Korea (June 22)
- "Semiclassical propagation: past, present and future" by Gabriel Lando, Laboratoire de Physique Théorique et Modèles Statistiques, France, Germany (June 23)
- "Analysis of KS eigenfunctions using a CNN in simulations of the MIT in doped semiconductors" by Keith Slevin & Tomi Ohtsuki, Osaka University & Sophia University, Japan (June 28)
- "Thermalization of isolated harmonic networks under conservative noise" by Stefano Lepri, Institute for Complex Systems, Italy (June 28)
- "Edge States, Solitons & Novel Phases of Topological Superfluids" by Jim Sauls, Northwestern University, USA (June 29), IBS Physics Colloquium @ Daejeon

You can find more seminars on *this page*.



PCS, with the Asia Pacific Center for Theoretical Physics, will run and host <u>IBSPCS-APCTP International Workshop</u> <u>Computational Approaches to Magnetic Systems</u> on August 17 – August 19, 2022. To apply for participation in the Workshop, complete the online <u>application form</u> by **July 16, 2022**.



PCS successfully hosted the *International Workshop Condensed Matter Solitons* June 29 – July 1, 2022 in zoom mode. We enjoyed twenty four invited talks including the *IBS physics colloquium* given by Jim Sauls (Northwestern University of Wisconsin Milwaukee, USA) with 112 participants.







New research results

Nanomechanical cat states generated by a dc voltage-driven Cooper pair box qubit

Danko Radić, Sang-Jun Choi, Hee Chul Park, Junho Suh, Robert I. Shekhter and Leonid Y. Gorelik

npj Quantum Information 8, 74

The authors propose a coherent mechanical state controlling entanglement using a movable superconductor, a nanoelectromechanical system (NEMS). The NEMS consists of a Cooper pair box, a qubit, performing vibrations between two bulk superconductors. The superconductors can generate states represented by entanglement between the qubit states and coherent mechanical states controlled by the bias voltage. The states are characterized by the corresponding Wigner function and entanglement entropy. In addition, they propose an experimentally feasible detection scheme in which the average current capturing the entanglement-induced feature can be measured.

Replica symmetry breaking in random non-Hermitian systems

Antonio M. García-García, Yiyang Jia, Dario Rosa, and Jacobus J. M. Verbaarschot

Phys. Rev. D 105, 126027 (arXiv:2203.13080)

The authors investigate the thermodynamic properties of a *PT*symmetric system composed of two random non-Hermitian Hamiltonians with no explicit coupling between them. After performing ensemble averaging, they identify numerically and analytically a robust first-order phase transition in the free energy of two models with quantum chaotic dynamics: the elliptic Ginibre ensemble of random matrices and a non-Hermitian Sachdev-Ye-Kitaev (SYK) model.





The free energy of the Ginibre model is temperature-independent in the low-temperature phase. The SYK model has a similar behavior for sufficiently low temperature, then it experiences a possible continuous phase transition to a phase with a temperature-dependent free energy before the first-order transition takes place at a higher temperature. The mechanism behind the transition is the existence of replica symmetry breaking configurations coupling Left and Right replicas that control the low-temperature limit of the partition function. They speculate that quantum chaos may be necessary for the observed dominance of off-diagonal replica symmetry breaking configurations in the low-temperature limit.

Puzzle of the month

June puzzle answer:

Yes, $Q = P^2 - 1$ is divisible by 24. $P^2 - 1 = (P - 1)(P + 1)$. Since *P* is prime and P > 3, it is odd, (P - 1) and (P + 1) are even and thus divisible by 2, and for obvious reasons one of them is even divisible by 4. So Q is divisible by 8. Moreover, every third integer is divisible by 3. Since P > 3 is prime it is not divisible by 3, either (P - 1) or (P + 1) is divisible by 3. So Q is at least divisible by 24.

Congratulations to Victor Kagalovsky for the correct answer!

Puzzle of the month:

There are about 1.5 million people living in Daejeon. Are there at least two among them who have the same number of friends? Note that a friendships are mutual.

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



