PCS NEWSLETTER

March 2022

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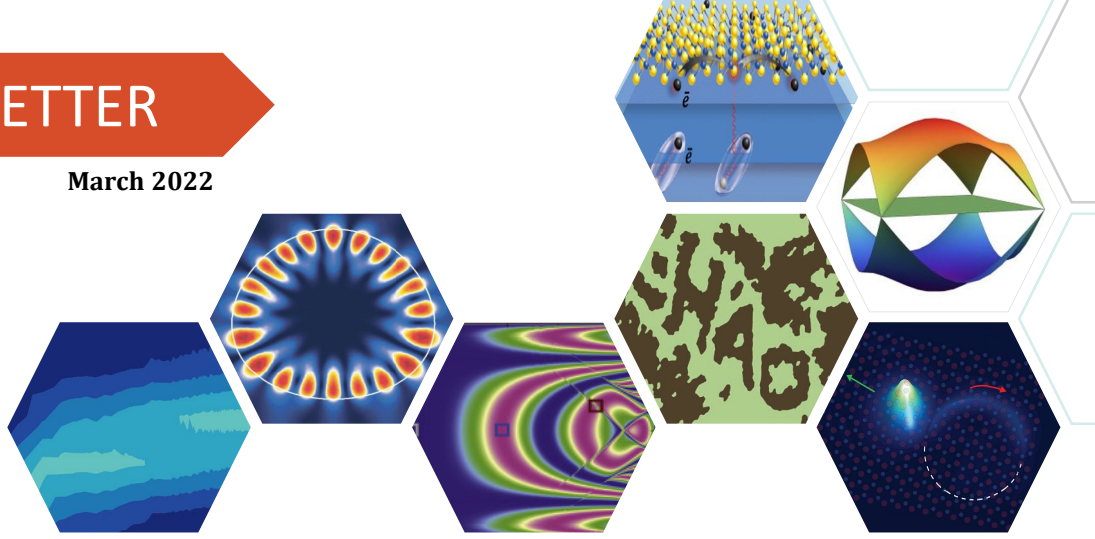


New members

Dr. Sonu Verma has joined PCS as a post-doctoral fellow and the team of Moon-Jip Park.
He recently received Ph. D. from the Indian Institute of Technology Kanpur.
His primary research interests are transport phenomena, correlation effects, spin-spin interactions, and superconductivity in spin-orbit coupled topological systems such as topological insulators and Luttinger semimetals.

PCS IBS Seminars

"Sub-diffusive Thouless time scaling in the Anderson model on random regular graphs"
by Luis Colmenarez, MPIPKS, Germany (Feb. 3)

"Neural quantum state of the long-range antiferromagnetic Ising chain"
by Dong-Hee Kim, Gwangju Institute of Science and Technology, Korea (Feb. 8)

"Many-body localization and topological order in disordered interacting Ising-Majorana chains"
by Nicolas Laflorencie, CNRS, France (Feb. 15)

"Spin-orbit splitting of Andreev states in Josephson weak links"
by Sunghun Park, Universidad Autónoma de Madrid, Spain (Feb. 17)

"Prethermal Phases of Matter"
by Johannes Knolle, Technical University of Munich, Germany (Feb. 22)

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

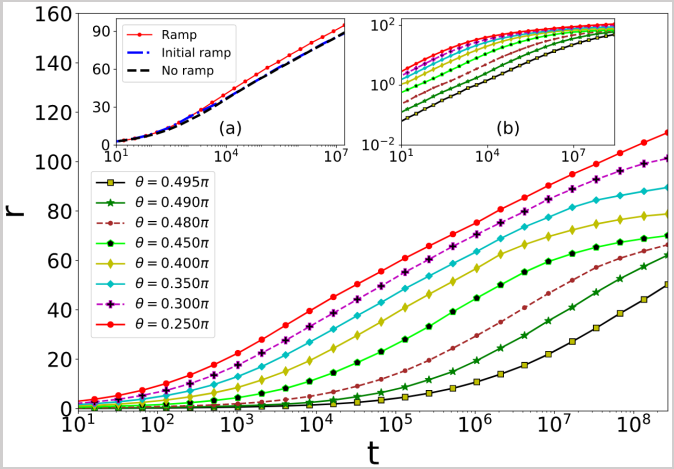
New research results

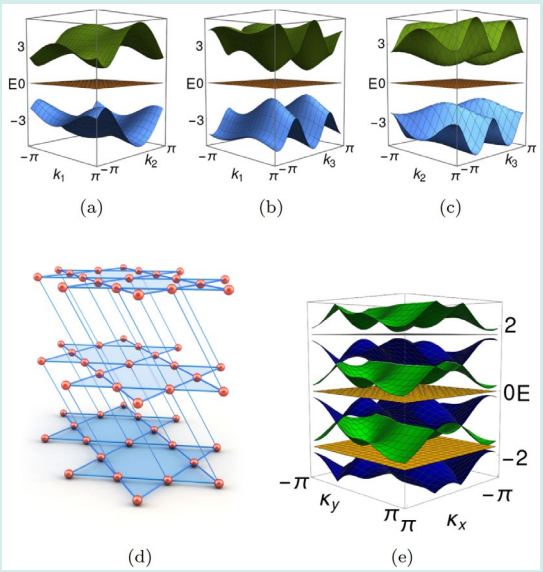
Logarithmic expansion of many-body wave packets in random potentials

Arindam Mallick and Sergej Flach

Phys. Rev. A Letters **105**, L020202 (arXiv:2107.09385)

Anderson localization confines a quantum particle in a one-dimensional random potential to a volume ~ the localization length, ξ. Nonlinear add-ons mimic many-body interactions on a mean-field level, and result in escape from the Anderson cage and in unlimited (sub)diffusion of the interacting cloud. The authors address quantum corrections of the mean-field many-body interactions, by using a discrete-time quantum walk platform and quantizing its nonlinear phases. They observe and explain a universal intermediate novel logarithmic expansion regime which connects the mean-field (sub)diffusion with the final saturation to a volume ~ $N\xi$.





Anti-*PT* Flatbands

Arindam Mallick, Nana Chang, Alexei Andreanov, and Sergej Flach

Phys. Rev. A Letters **105**, L021305 (arXiv:2108.01845)

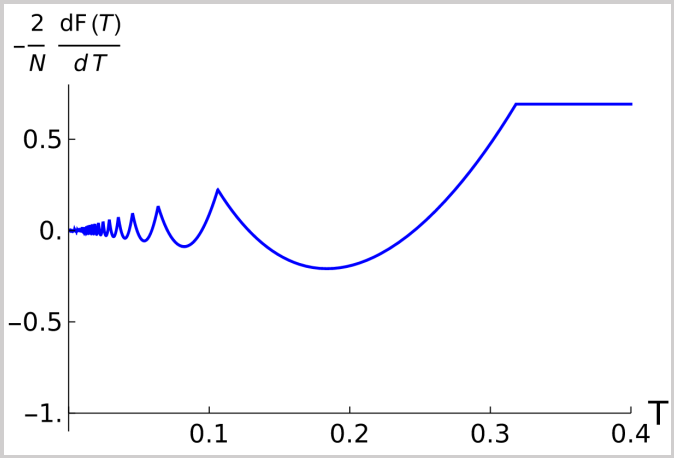
The authors introduce a new class of flatbands in tight-binding single-particle Hermitian Hamiltonians on *d*-dimensional non-Bravais lattices with odd number of sublattices, which are invariant under an antiunitary antisymmetry: the anti-*PT* symmetry. They derive the anti-*PT* constraints on the Hamiltonians and use them to generate examples of generalized kagome networks in two and three lattice dimensions. They further show that the anti-*PT* symmetry protects flatbands in the presence of uniform DC fields. Examples of the Wannier-Stark band structure of generalized kagome networks in the presence of DC fields, and their implementation using Floquet engineering are provided.

Dominance of Replica Off-Diagonal Configurations and Phase Transitions in a *PT* Symmetric Sachdev-Ye-Kitaev Model

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

Phys. Rev. Lett. **128**, 081601 (arXiv:2102.06630)

The authors show that, after ensemble averaging, the low temperature phase of a conjugate pair of uncoupled, quantum chaotic, non-Hermitian systems such as the Sachdev-Ye-Kitaev (SYK) model or the Ginibre ensemble of random matrices is dominated by saddle points that couple replicas and conjugate replicas. This results in a nearly flat free energy that terminates in a first-order phase transition. In the case of the SYK model, they show explicitly that the spectrum of the effective replica theory has a gap. These features are strikingly similar to those induced by wormholes in the gravity path integral which suggests a close relation between both configurations.



Puzzle of the month

February puzzle answer:

The eligible cases are those when we randomly choose a box, and take a coin out, which turns to be gold. That leaves the silver/silver box out of consideration. The boxes g/g and g/s are picked with equal probability, but 50% of the g/s box choices are excluded, as a random coin choice from them will result in silver. Therefore the probability to pick a second gold coin from the same box is 2/3.
The correct answers came from Amnon Aharony and Ihor Vakulchyk. Congratulations!

Puzzle of the month:

Paul and Mary play a game with a fair coin - both heads (H) and tails (T) have same probability 1/2.
Paul chooses the sequence TT. Mary chooses HT.
They start flipping the coin several times in a row, until either TT or HT happen. Is that a fair game? What are the probabilities for Paul and Mary to win? Why? What if Mary chooses TH instead?

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