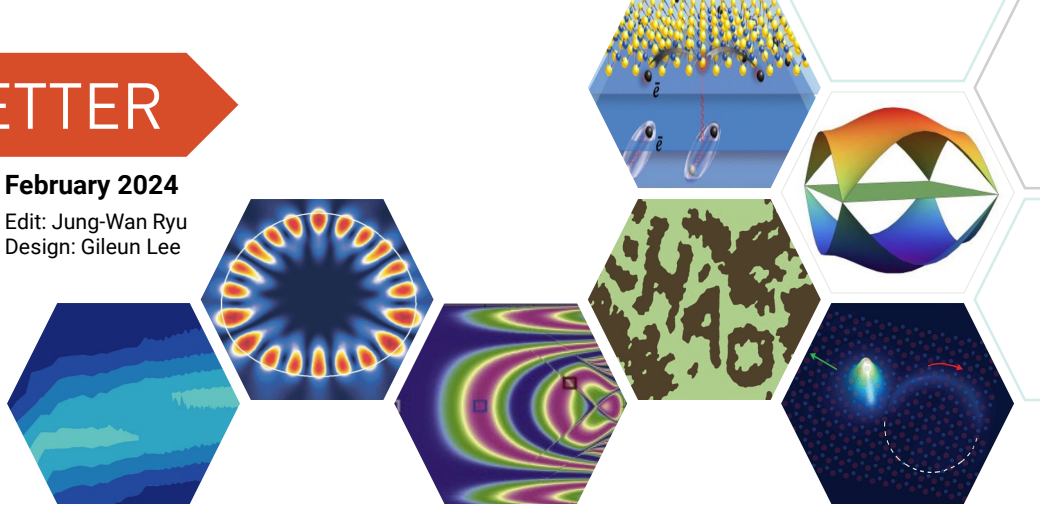
PCS NEWSLETTER

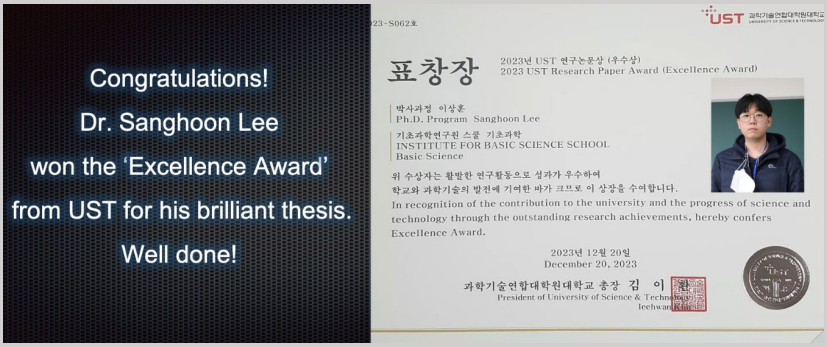
February 2024

Edit: Jung-Wan Ryu
Design: Gileun Lee

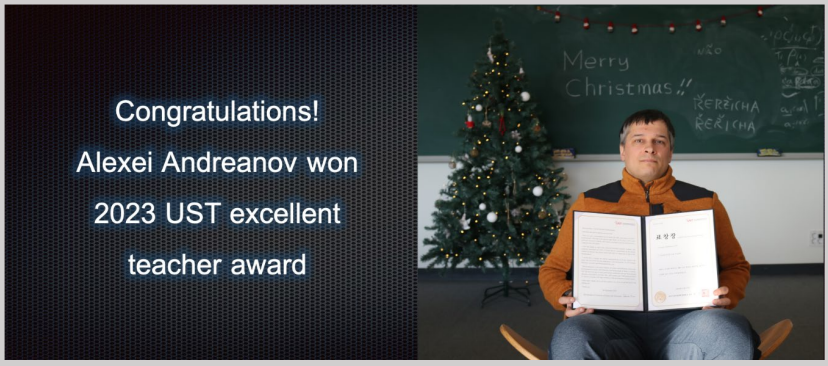
QR to PCS Webpage



Awards



Congratulations!
Sanghoon Lee won the 'Excellence Award' from UST for his brilliant thesis.



Congratulations!
Alexei Andreanov won 2023 UST excellent teacher award.

PCS IBS Seminars

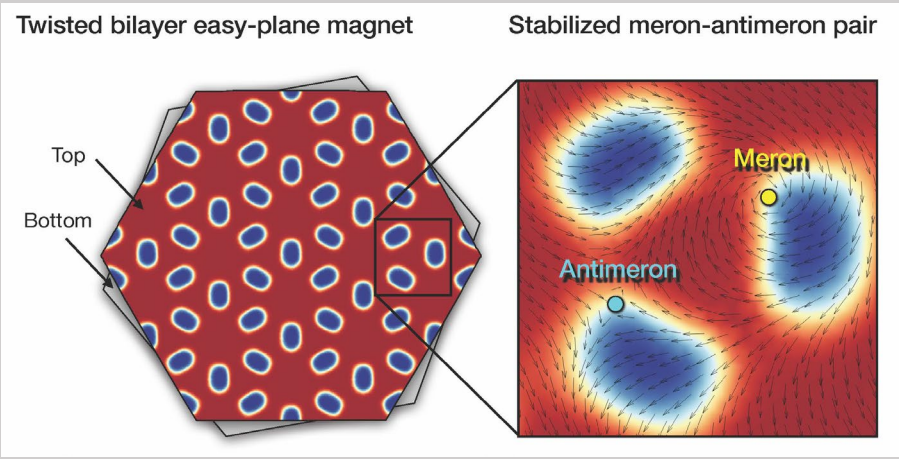
"Correlated order at the tipping point in the kagome metal CsV3Sb5"
by Glenn Wagner, University of Zurich, Switzerland (January 4)

"Resonant fractional conductance in 1D Wigner chains"
by Rose Davies, Aston University, UK (January 25)

"Exploring Light-Induced Phenomena in Condensed Matter Physics within the Framework of Density-Functional Theory"
by Bumseop Kim, Ulsan National Institute of Science and Technology (UNIST), Korea (January 30)

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

New Research Results



Emergence of Stable Meron Quartets in Twisted Magnets

Kyoung-Min Kim, Gyungchoon Go, Moon Jip Park, and Se Kwon Kim

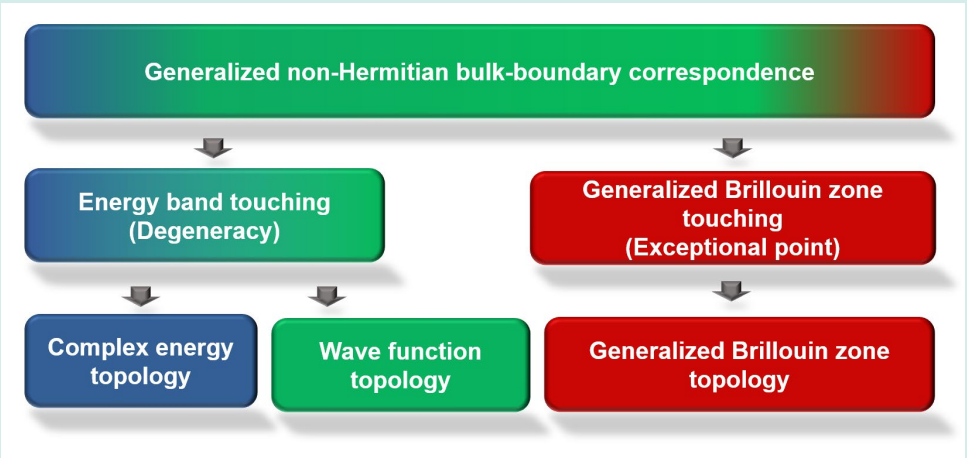
Nano Lett. 24, 74−81 (2024)

Twist engineering emerges as an effective avenue for generating topological spin textures, such as skyrmions. In this study, the authors introduce a novel approach to achieving fractional topological spin textures characterized by exotic half-skyrmion numbers, such as merons. By utilizing atomistic spin simulations on twisted bilayer magnets, the authors demonstrate the formation of a stable double Meron pair, which they refer to as the "Meron Quartet"(MQ). Unlike a single pair, the merons within the MQ exhibit exceptional stability against pair annihilation due to the protective localization mechanism induced by the twist that prevents collision of the Meron cores. Their findings highlight the twisted magnet as a promising platform for achieving merons as stable magnetic quasiparticles in van der Waals magnets.

Topological phase transitions of generalized Brillouin zone

Sonu Verma & Moon Jip Park

Communications Physics 7, 21 (2024)



A generic feature of topological phases of matter is the bulk-boundary correspondence (BBC) which connects the concept of bulk topology to the emergence of robust boundary states. Recent studies prove that non-Hermitian systems show two types of BBCs: (i) complex energy topology of the bulk leads to non-Hermitian skin effect, where all bulk states localize at one boundary of the system, and (ii) wave function topology leads to the conventional topological boundary modes. In this work, the authors go beyond the known description of the non-Hermitian topological phase and find a different type of BBC, which originates from the intrinsic topology of the generalized Brillouin zone (GBZ). Topologically non-trivial GBZ appears due to general boundary conditions that break the translation symmetry of the system. In their case, the topological phase transition is characterized by the generalized momentum touching of GBZ, which accompanies the emergence of exceptional points. As a realization of their proposal, the authors suggest the non-reciprocal Kuramoto oscillator lattice, where phase slips accompany exceptional points as a signature of such topological phase transition. Their work establishes an understanding of non-Hermitian topological matter by complementing the non-Hermitian BBC as a general foundation of the non-Hermitian topological systems.

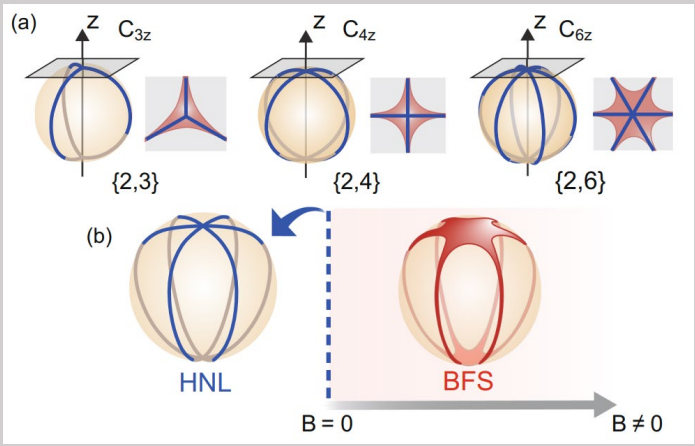
New Research Results

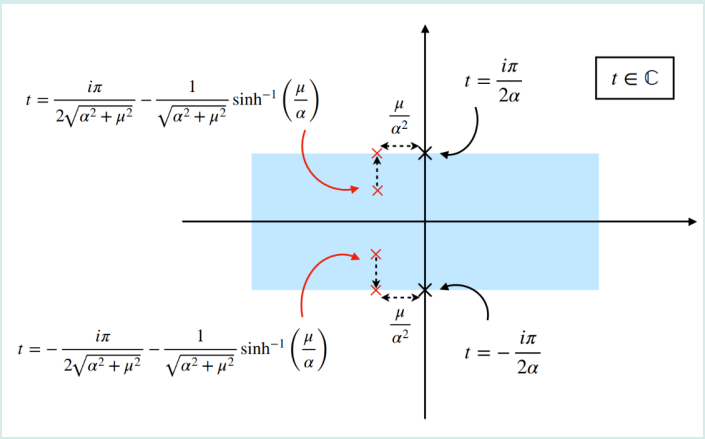
Hosohedral nodal-line superconductivity in hexagonal ABC Dirac semimetals

Hong-Guk Min, Churlhi Lyi, Moon Jip Park & Youngkuk Kim

Communications Physics 7, 11 (2024)

The interplay between band topology and strong correlation underpins the motivations for the search for topological superconductivity. Dirac semimetal, one of the most profound forms of the topological semimetal, is experimentally found in the material class so-called hexagonal ABC ternary systems such as KZnBi. This material exhibits superconductivity at 0.8K. The question is now what would be the superconducting nature of such Dirac semimetal systems? Their theory shows that the underlying Dirac particles contribute to the nodal line superconductivity that geometrically resembles the hexagonal hosohedron, which fits with the experimental observations of the gapless feature of the superconducting phase. Their result shows that KZnBi as a strong candidate of topological superconductivity.





Operator dynamics in Lindbladian SYK: A Krylov complexity perspective

Budhaditya Bhattacharjee, Pratik Nandy & Tanay Pathak

J. High Energ. Phys. 2024, 94 (2024)

The authors use Krylov complexity to study operator growth in the q-body dissipative Sachdev-Ye-Kitaev (SYK) model, where the dissipation is modeled by linear and random p-body Lindblad operators. In the large q limit, they analytically establish the linear growth of two sets of coefficients for any generic jump operators. They connect these observations to continuous quantum measurement processes. They further investigate the pole structure of a generic auto-correlation and the high-frequency behavior of the spectral function in the presence of dissipation, thereby revealing a general principle for operator growth in dissipative quantum chaotic systems.

Puzzle of the Month

January puzzle solution:

The total number of lightnings is N*M and at the same time N(N+1)/2. Therefore M=(N+1)/2 and the number of candles N must be odd. The strategy of burning is also simple - always lighten those candles which are the longest on any given day.
The first correct solution was submitted by Oleg Utesov. Congratulations!
Slightly later we also received correct solutions from Alireza Akbari and Victor Kagalovski, excellent!

Puzzle of the month:

A gardener finds that a number of newly grown plants grew up in her garden. Upon closer inspection, she realizes that the number of seed capsules per new plant equals the number of new plants. Also the number of seeds per seed capsule equals the number of seed capsules of the given plant. The gardener collects all seeds and distributes them evenly among all of her seven friends as a present. A few seeds remain, and she keeps them for herself. How may did she keep?

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