PCS NEWSLETTER

QR to PCS Webpage

October 2023
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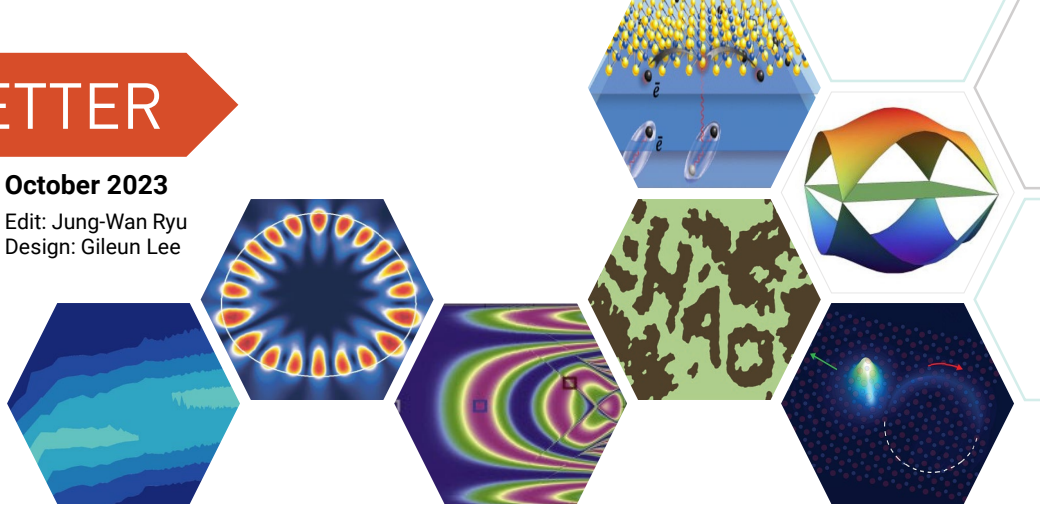
Design: Gileun Lee



New Members

Dr. Kabyashree Sonowal has joined PCS as a post-doctoral fellow. She recently received her PhD from University of Science and Technology, Korea - Institute for Basic Science (UST-IBS). She works in transport and response phenomena in both normal and superconducting regimes of 2D materials, focusing on strain-tuned transport and optical response phenomena. Her research interests broadly span a variety of research questions in the area of superconductivity, non-equilibrium physics, and 2D materials.

Dr. Olha Bahrova has joined PCS as a post-doctoral fellow. She recently received her PhD from the B.I. Verkin Institute for Low Temperature Physics and Engineering of National Academy of Sciences of Ukraine. Her main research interests are exciton-polariton fluid dynamics, non-linear transport and quantum thermodynamics with qubit-oscillator systems.

PCS Workshops and Meetings

PCS will co-host Asian Network School and Workshop on Complex Condensed Matter Systems 2023 at the Institute of Physics, Hanoi, Vietnam on November 6 – November 10, 2023.

PCS Seminars

"Multipole higher-order topology and flat bands in a multimode lattice"
by Maxim Gorlach, ITMO University, Russia (September 5)

"Constructing the 3D analytical response of the metallic half-space to an external charge"
by Tomasz Bednarek, Institute of Physical Chemistry PAS, Poland (September 7)

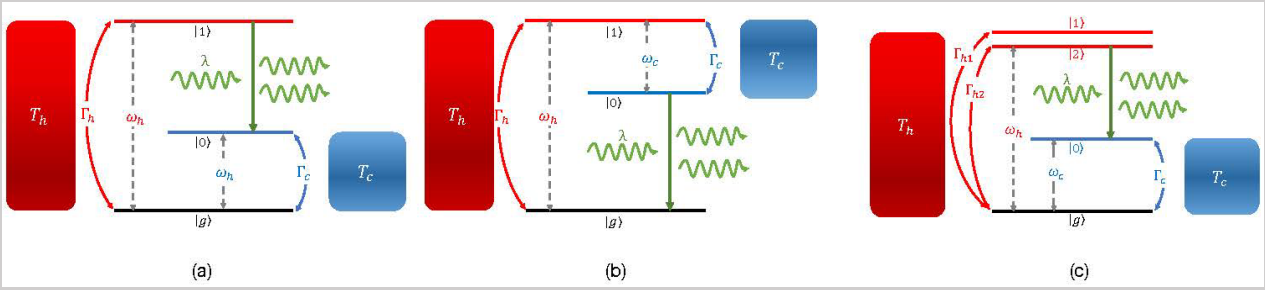
"Polaritons in emerging materials: from fundamentals to recent developments"
by Sven Höfling, Julius-Maximilians-Universität Würzburg, Germany (September 12), *IBS Physics Colloquium @ Daejeon*

"Spin-boson model for nonlinear optical conductivity of graphene"
by Sushanta Dattagupta, National Institute of Technology Durgapur, India (September 19)

"Nanomechanical control of superconducting charge-qubit networks"
by Danko Radić, University of Zagreb, Croatia (September 26)

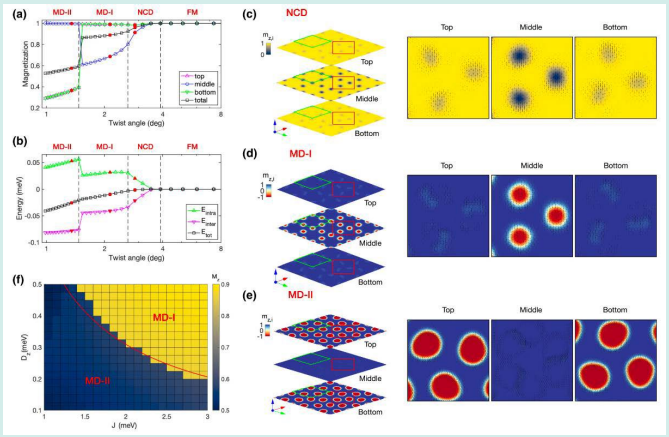
You can find more seminars on ***this page***.

New Research Results



Thermodynamic uncertainty relation in nondegenerate and degenerate maser heat engines
Varinder Singh, Vahid Shaghaghi, Özgür E. Müstecaplıoğlu, and Dario Rosa
Phys. Rev. **A** 108, 032203 (2023)
In this work, the authors investigate the thermodynamic uncertainty relation (TUR), i.e., a tradeoff between entropy production rate and relative power fluctuations, for nondegenerate three-level and degenerate four-level maser heat engines. In the nondegenerate case, the authors consider two slightly different configurations of the three-level maser heat engine and contrast their degree of violation of the standard TUR. The authors associate their different TUR-violating properties to the phenomenon of spontaneous emission, which gives rise to an asymmetry between them. For the degenerate four-level engine, the authors show that the phenomenon of noise-induced coherence can be employed to suppress the relative power fluctuations.

New Research Results



Controllable magnetic domains in twisted trilayer magnets

Kyoung-Min Kim and Moon Jip Park

Phys. Rev. **B** 108, L100401 (2023)

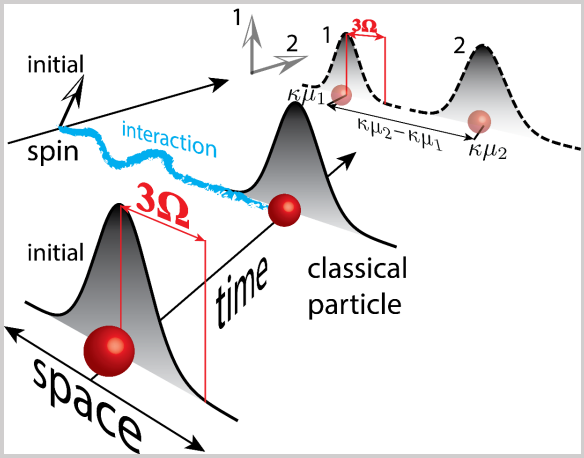
The utilization of moiré patterns emerges as a promising tool for generating exotic magnetic structures in two-dimensional van der Waals magnets. While previous research has mainly focused on twisted bilayer systems, the study takes a step further by delving into the magnetic structure of twisted trilayer magnets. The numerical simulations reveal that enhanced complexity of magnetic coupling, such as four distinct interlayer exchange couplings, results in the unexpected appearance of novel magnetic structures, even in the small twist angle regime. Moreover, the authors show that these structures can be readily manipulated by applying external magnetic fields without fine-tuning the twist angle. In addition to advancing the understanding of magnetic structures in layered materials, these findings hold promise for the development of novel magnetic devices and technologies.

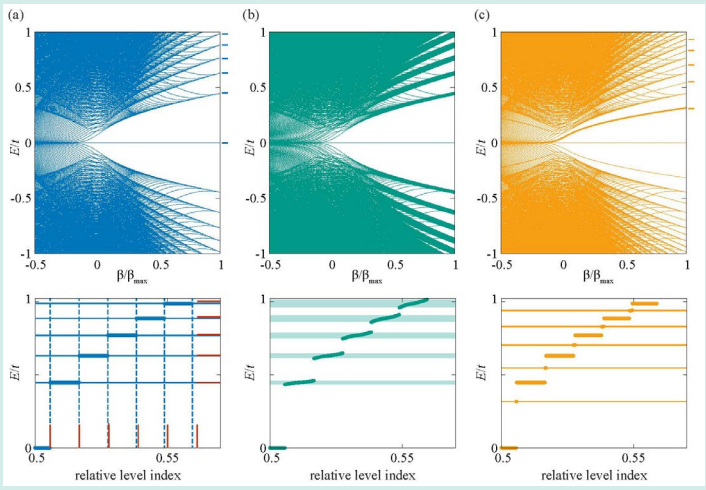
Quantifying information extraction using generalized quantum measurements

Dominik Šafránek and Juzar Thingna

Phys. Rev. **A** 108, 032413 (2023)

The authors show that it is possible to generalize observational entropy to general measurements (POVMs) and that the three important properties still hold, justifying the interpretation of observational entropy as a measure of observers' knowledge about the system obtained through measurement. The authors apply this to various von Neumann measurement schemes, which use a classical particle as a probe to measure the system of interest, and the authors derive which types perform the best under various circumstances..





Flux-induced midgap states between strain-engineered flat bands

Dung X. Nguyen, Jake Arkinstall, and Henning Schomerus

Phys. Rev. **B** 108, 115148 (2023)

The work establishes a deep, general, and highly predictive connection of the standard microscopic models of such systems with a continuum theory of Dirac fermions in a hyperbolic space with an emergent metric, which appears naturally even though the physical system is flat. The authors show that this description explains the strain-induced physics not only much more precisely, but also reveals completely new phenomena. (1) For the first time, provide direct and compelling evidence for the relativistic Wen-Zee shift in a negative curvature space. (2) The authors explain a previous experimental puzzle of the interplay of strain with a real magnetic field, where the emergent metric explains the broadening of the pseudo-Landau levels. (3) The authors uncover a novel topological effect, resulting in a unique sequence of midgap states obtained from a flux vortex.

Puzzle of the Month

September puzzle answer:

Disappointingly we did not get any answers so far. Come on! There is no puzzle that physicists can't solve! We repeat the puzzle. You have one month to solve it, send the solution to us, and become famous!

Puzzle of the month:

There are 1000 marbles on the table. John and Mary play the following game: John starts and takes some marbles off the table. Then Mary takes some marbles off the table. Then John again, and so on. Note they each time they are allowed to remove only either1, or 2, or 4, or 9, or 16 marbles. The winner is the one who removes the last marbles from the table. Is there a winning strategy? Who will win?

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