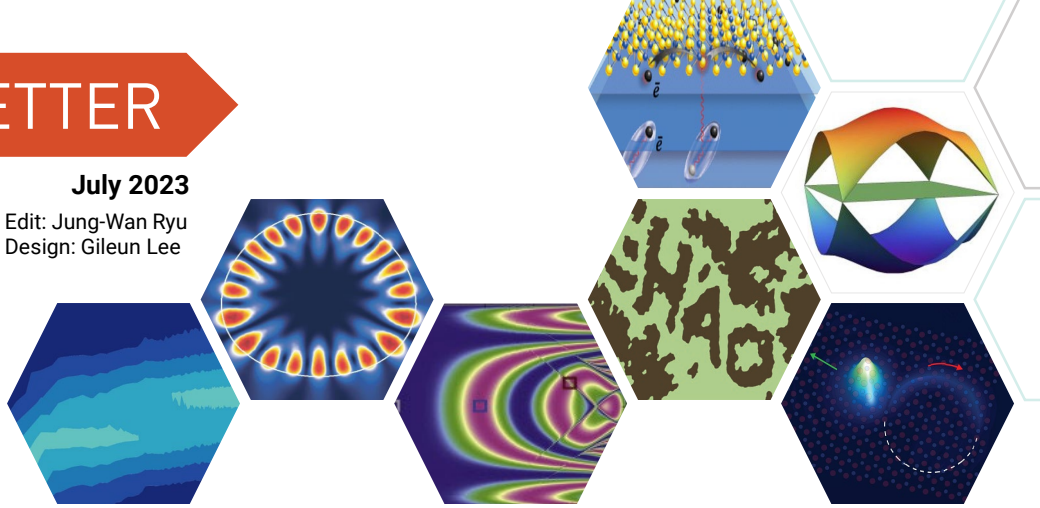
PCS NEWSLETTER

QR to PCS Webpage

July 2023
Edit: Jung-Wan Ryu
Design: Gileun Lee



PCS Workshops and Meetings

PCS will co-host Numerical Methods in Theoretical Physics 2023 at the Asia Pacific Center for Theoretical Physics (APCTP) on July 10 – July 14, 2023.

PCS IBS Seminars

"QML for optimization via variational algorithms and coordinate transformations"
by Pablo Bermejo, Donostia International Physics Center, Spain (June 8)

"Strongly interacting impurities in a dilute Bose condensate"
by Nikolay Yegovtsev, University of Colorado Boulder, USA (June 12)

"Superconductivity from repulsive interactions in Bernal bilayer"
by Glenn Wagner, Zurich University, Switzerland (June 13)

"Measuring exotic entropy in the mesoscopic systems"
by Cheolhee Han, Tel Aviv University, Israel (June 15)

"Extraction of ergotropy: free energy bound and application to open cycle engines"
by Tanmoy Biswas, University of Gdansk, Poland (June 20)

"Gravity and cosmology beyond general relativity"
by Shinji Mukohyama, Yukawa Institute for Theoretical Physics, Kyoto University (June 22),
IBS Physics Colloquium @ Daejeon

"Floquet engineering: exploring control and phenomena of high-frequency electromagnetic fields in condensed-matter structures"
by Upendra Kumar, Korea Institute of Ceramic Engineering and Technology, Korea (June 26)

"Principles of self-assembly for particles with simple geometries and complex interactions"
by Lara Koehler, Université Paris Saclay, France (June 27)

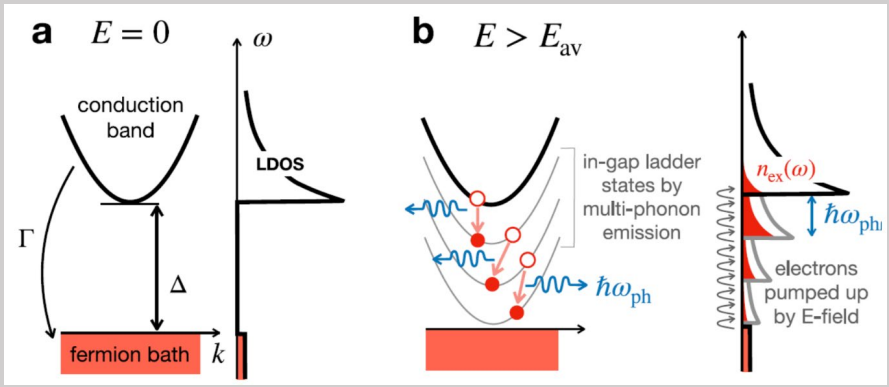
You can find more seminars on ***this page***.

New Research Results

Correlated insulator collapse due to quantum avalanche via in-gap ladder states

Jong E. Han, Camille Aron, Xi Chen, Ishiaka Mansaray, Jae-Ho Han, Ki-Seok Kim, Michael Randle & Jonathan P. Bird

Nature Communications 14, 2936 (2023)

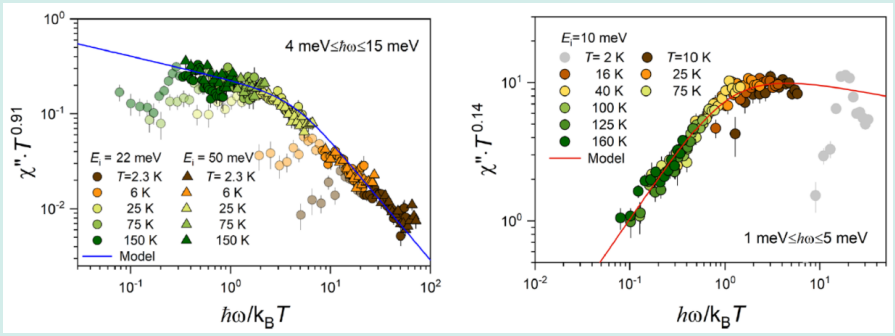


The microscopic mechanism of insulator-to-metal transition under the large electric DC field is a long-standing problem in strongly correlated electron systems. The conventional Zenner tunneling mechanism fails to explain the critical electric field strength in experiments which is smaller than the gap size of the insulating phase. In this work, the authors investigate one-dimensional systems coupled to phonons under a large DC electric field. They found that the phonons make a ladder of in-gap states, and the multi-phonon emission trigger the phase transition. Also, their study demonstrates how a crossover between the thermal and quantum switching scenarios emerges within a unified framework of the quantum avalanche.

Weak-coupling to strong-coupling quantum criticality crossover in a Kitaev quantum spin liquid α-RuCl3

Jae-Ho Han, Seung-Hwan Do, Kwang-Yong Choi, Sang-Youn Park, Jae-You Kim, Sungdae Ji, Ki-Seok Kim & Jae-Hoon Park

npj Quantum Materials 8, 33 (2023)

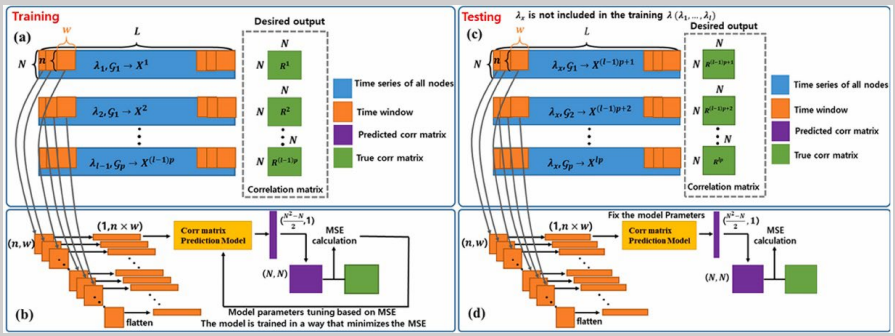


α-RuCl3 is one of the promising candidate materials for Kitaev quantum spin liquids (QSL). in addition to the Kitaev interaction, other magnetic interactions in this material make long-range order in the ground state instead of QSL. In this work, the authors show that this material is near the critical region of the long-range order fluctuations and coupled with the Kitaev QSL. There are two fixed points: a high-energy weak-coupling fixed point that shows the Kitaev QSL and a low-energy strong-coupled fixed point that shows local quantum criticality. The local quantum criticality is a new finding and is complementary picture to the Kitaev QSL in this material.

Estimation of correlation matrices from limited time series data using machine learning

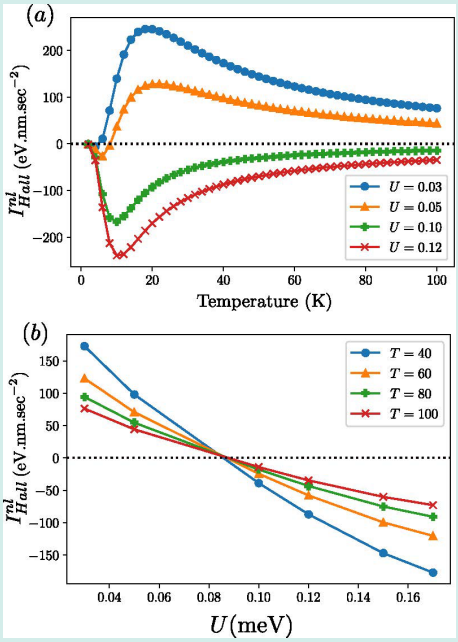
Nikhil Easaw, Woo Seok Lee, Prashant Singh Lohiya, Sarika Jalan, Priodyuti Pradhan

Journal of Computational Science 71, 102053 (2023)



Correlation matrices contain a wide variety of spatio-temporal information about a dynamical system. In this work, the authors use a supervised machine learning technique to predict the correlation matrix of entire systems from finite time series information of a few randomly selected nodes. The accuracy of the prediction validates that only a limited time series of a subset of the entire system is enough to make good correlation matrix predictions. Furthermore, using an unsupervised learning algorithm, they furnish insights into the success of the predictions from our model. Finally, they employ the machine learning model developed here to real-world data sets.

New Research Results



Nonlinear magnon transport in bilayer van der Waals antiferromagnets

Rohit Mukherjee, Sonu Verma, and Arijit Kundu

Phys. Rev. B 107, 245426 (2023)

In this work, the authors study the Berry curvature-induced linear and nonlinear magnon transport in bilayer van der Waals antiferromagnets, where the authors deduce forms for the spin and energy currents within the semiclassical Boltzmann formalism under the relaxation time approximation. Even in the absence of the Dzyaloshinskii-Moriya interaction, finite layer-dependent electrostatic doping (ED) potential, and anisotropy in the Heisenberg interactions, give rise to a nonzero nonlinear thermal Hall response resulting from higher moments of the Berry curvature [Fig. (a)], whereas, the linear response remains zero. The nonlinear thermal Hall conductivity shows a sign reversal with varying strength of ED potential (U) [Fig. (b)], which can be potentially useful to experimentalists and spin-based technologies.

Puzzle of the Month

June puzzle answer:

it is all about the center of mass location. For any regular car it is located above the wheel axis. And so it goes. Breaking and inertia will tip you over the front wheel axis. Accelerating and inertia will tip you over the rare wheel axis. To invert everything, you'd have to move the center of mass close to the ground and below the wheel axis.

Congratulations to Sang-Jun Choi (Wuerzburg) for the first and correct solution.

Puzzle of the month:

Selma goes for lunch to the local cafeteria. She has less than 10 Euro cash in her pocket. She notes that the dish she orders has a price which can be obtained from permuting the digits of her pocket money. After purchasing the meal she realizes that the change she got is again given by a permutation of the digits of her pocket money she entered the cafeteria with. How much was in her pocket when she entered the cafeteria?

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