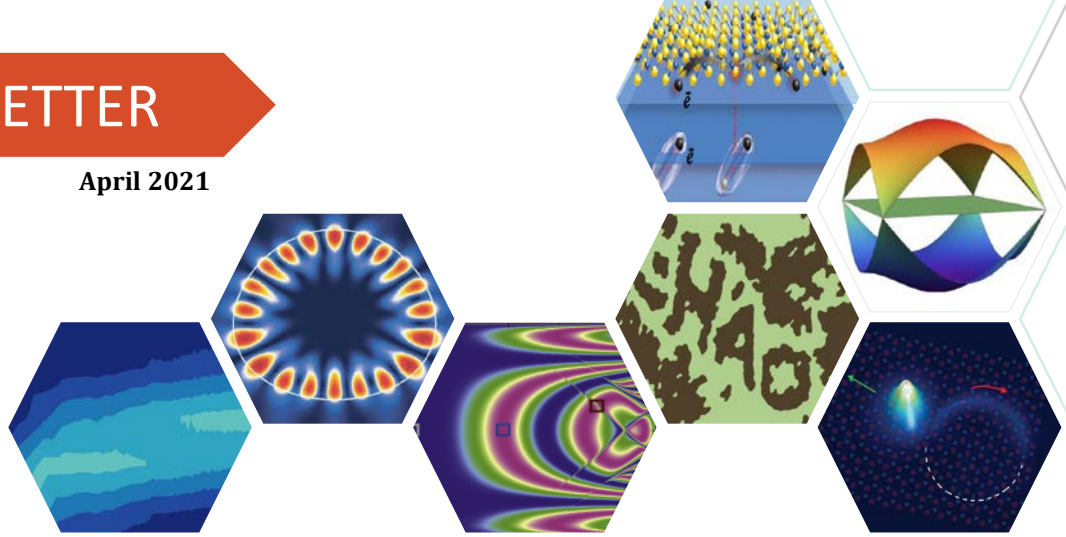




Edit: Sungjong Woo
Design: Gileun Lee



New members



PCS welcomes **Moon Jip Park** as our new Junior Research Team Leader. The team research focuses on unconventional/topological superconductivity, magnetism, disordered systems, and quasicrystals. One of the ultimate goals is to understand how to topologically classify complex many-body interacting systems.

We are currently inviting new team members. For interested applicants, please contact moonjipark@gmail.com or pcs@ibs.re.kr.

PCS welcomes **Chang-Hwan Yi** as a Research Fellow.

He works on quantum-chaos phenomena in non-Hermitian systems, particularly in two-dimensional chaotic-optical-microcavities. He is interested in broad aspects of non-Hermitian degeneracies in both isolated and coupled systems, as well as in developing an efficient numerical method to compute resonant modes in optical systems.



PCS welcomes **Juyeon Kim** (SNU) as a student trainee in the team Quantum Chaos in Many-Body Systems. He is interested in open quantum systems such as quantum batteries, especially on the question of how many body effect and quantum entanglement can enhance the performance of quantum batteries.

PCS Workshops and Meetings

The International Workshop Open Quantum Dynamics and Thermodynamics was a huge success with almost one hundred participants, excellent presentations, and two lively and exciting poster sessions with everyone turning avatars.

PCS will have an online Retreat meeting Apr 28-30 with additional participants from two Junior Research groups of the Asia-Pacific Center for Theoretical Physics (Pohang).

We will run two newly added events: International Workshop Quantum Many-Body Dynamics: Thermalization and its Violations (May 24-28 2021) and an International Workshop Advances in Flatband Physics (July or August 2021).

New research results

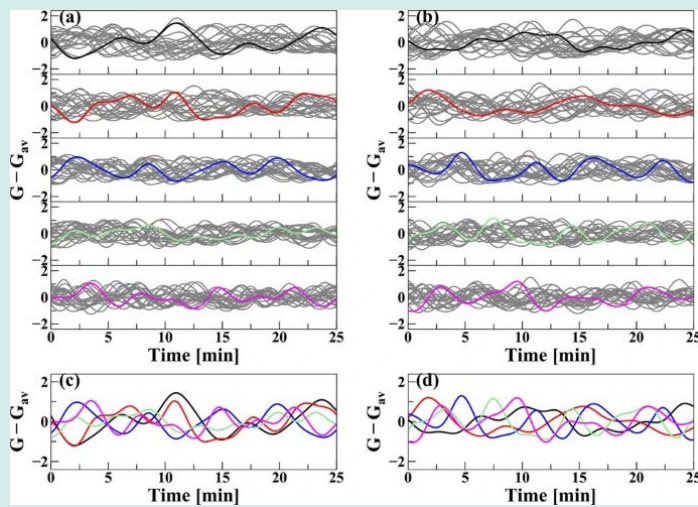
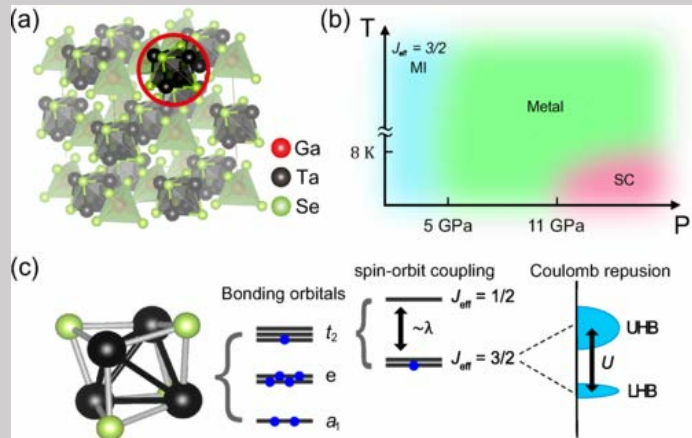
Jeff=3/2 metallic phase and unconventional superconductivity in GaTa4Se8

Phys. Rev. B **103**, L081112

(<https://arxiv.org/abs/2010.09234>)

Min Yong Jeong, Seo Hyoung Chang, Hyeong Jun Lee, Jae-Hoon Sim, Kyeong Jun Lee, Etienne Janod, Laurent Cario, Ayman Said, Wenli Bi, Philipp Werner, Ara Go, Jungho Kim and Myung Joon Han

This work has reported that one of the molecular-orbital systems, GaTa4Se8, under high pressure carries the Jeff=3/2 moment within both theoretical and experimental approaches. It's the first confirmed example of Jeff=3/2 moments residing in metal. It indicates the superconductivity of this material is likely unconventional in close relation to the J-freezing crossover. The pressure-dependent resonant inelastic x-ray scattering (RIXS) spectra capture the clear orbital excitations as well as the density functional theory and dynamical mean-field theory (DFT+DMFT) study provides single-particle spectra and self-energies capturing its incoherence of electronic transport for various pressures and electron dopings.



Machine learning for the diagnosis of early stage diabetes using temporal glucose profiles

J. Korean Phys. Soc. **78**, 373

(<https://arxiv.org/abs/2005.08701>)

Woo Seok Lee, Junghyo Jo and Taegeun Song

In this study, the authors have checked whether machine learning could detect the patterns of blood glucose level (BGL) under insulin resistance. The temporal change of BGL results from the balanced response to the counter-regulatory hormones, insulin and glucagon. Thus the ineffective action of insulin, called insulin resistance, should affect the BGL profile. They have simulated the glucose profiles under insulin resistance by using a biophysical model for the glucose regulation, confirming that the subtle change of glucose profiles under insulin resistance can be recognized by various machine-learning methods. This demonstrates a great potential of the machine learning approach for the diagnosis of early-stage diabetes.

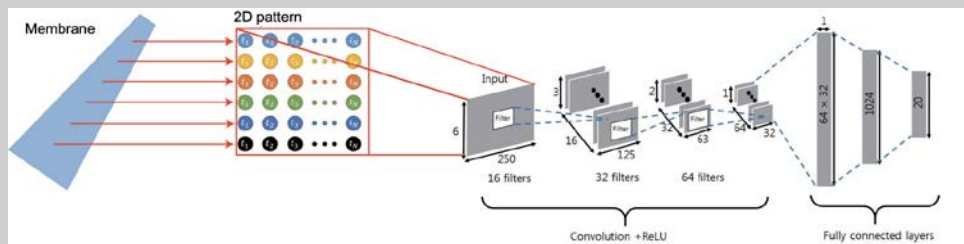
Fast frequency discrimination and phoneme recognition using a biomimetic membrane coupled to a neural network

Bioinspir. & Biomim. **16**, 026012

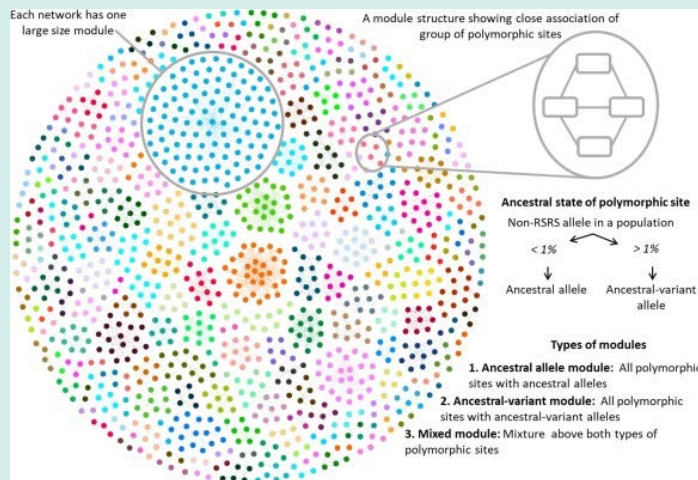
(<https://arxiv.org/abs/2004.04459>)

Woo Seok Lee, Hyunjae Kim, Andrew N Cleland and Kang-Hun Ahn

The authors have demonstrated an artificial basilar membrane (ABM) with a frequency-dependent spatial response which, when combined with a trained pattern recognizing neural network, shows outstanding performance in frequency resolution as well as speech recognition of short-time phonemes. This artificial system mimics the human auditory system's ability to resolve and distinguish very short segments of speech, and shows strong potential for the analysis of more complex spoken sounds. Compared to other spectral zoom methods (ZFFT and CZT), the pattern recognition of the ABM can improve speech recognition in short time intervals. This may provide an important clue as to why real-time speech recognition is possible for humans.



New research results



Impact of modular mitochondrial epistatic interactions on the evolution of human subpopulations

Mitochondrion. 58, 111

(<https://www.biorxiv.org/content/10.1101/505818v2.full>)

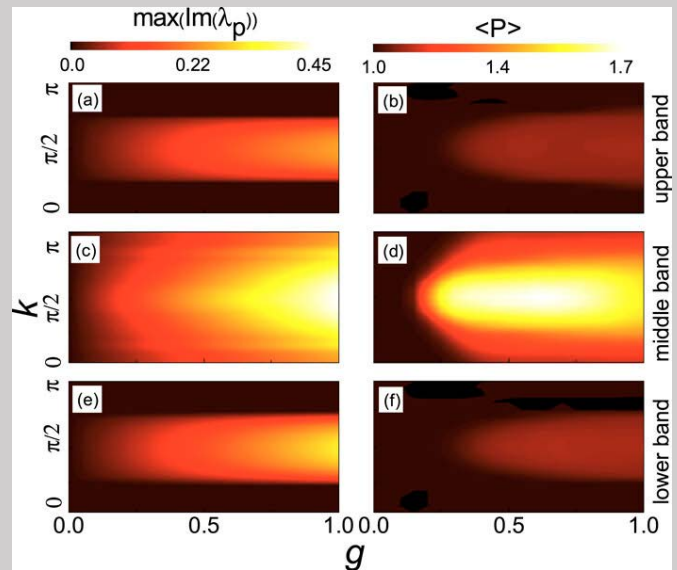
Pramod Shinde, Harry J Whitwell, Rahul Kumr Verma, Mikhail Ivanchenko, Alexey Zaikin and Sarika Jalan

Investigation of human mitochondrial genome variation has been shown to provide insights to the human history and natural selection. By analyzing 24,167 human mitochondrial genome samples, collected for five continents, the authors have developed a co-mutation network model to study human evolutionary patterns. The analysis shows richer co-mutating regions of the mitochondrial genome, suggesting the presence of epistasis. It further demonstrates hierarchical modularity as a crucial agent for such co-mutation networks. Their ancestry-based co-mutation module analyses shows that mutations cluster preferentially in known mitochondrial haplogroups. Overall, these results demonstrate that subpopulation-based biases may favor mitochondrial gene specific epistasis.

Nonlinear Bloch wave dynamics in photonic Aharonov-Bohm cages

APL Photon. 6, 030801

Nana Chang, Sinan Gundogdu, Daniel Leykam, Dimitris G Angelakis, SuPeng Kou, Sergej Flach and Aleksandra Maluckov
The authors have studied the properties of nonlinear Bloch waves in a diamond chain waveguide lattice in the case of Aharonov-Bohm caging (all bands flat system), which becomes sensitive to k , exhibiting bifurcations and instabilities. The instabilities can result in either the spontaneous or controlled formation of localized modes, which are immobile and remain pinned in place due to the synthetic magnetic flux.



Puzzle of the month

Shirin chose a number between 1 and 999. You need to figure the right one with at most 7 questions to Shirin, to which the answer of Shirin could be 'yes', 'no', or 'don't know'. The question is - what are the questions?

Send your solution to eun@ibs.re.kr.

The winner will be announced in the next issue.

March puzzle answer: 1/2 (amazing, isn't it?)

The winner is: Saebyeok Ahn (IBS/CAPP), who sent a detailed AND correct solution faster than anyone else.
CONGRATULATIONS!