PCS NEWSLETTER

QR to PCS Webpage

November 2023

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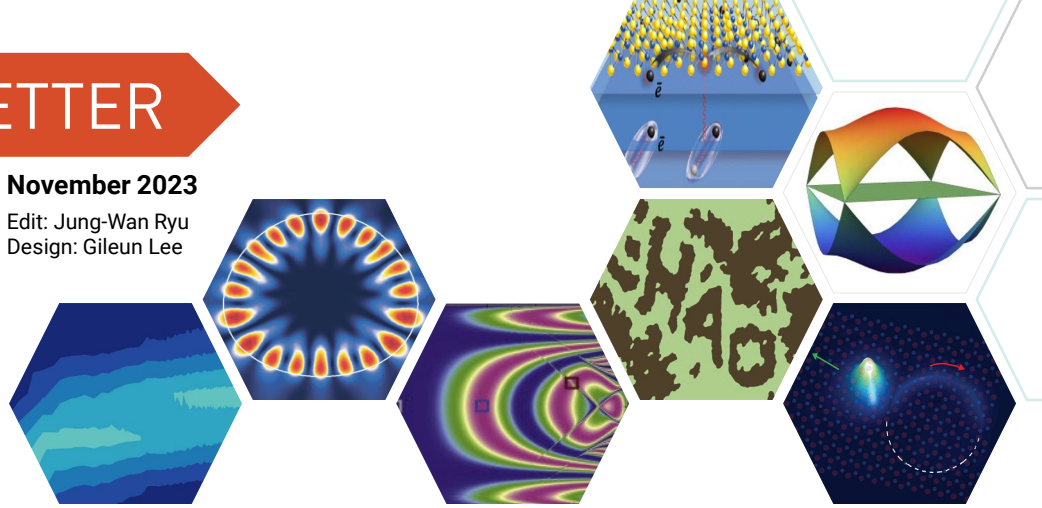


New Members

Dr. Dogyun Ko has joined PCS as a post-doctoral fellow. He received his PhD from the University of Science and Technology, South Korea - Institute for Basic Science (UST-IBS). His primary research interests focus on exciton-polariton condensates and valleytronics in 2D materials. Additionally, he has recently broadened his focus on quantum neural networks.

PCS Workshops and Meetings

PCS will co-host KIAS-IBS-PCS Workshop Correlation and Topology in Quantum Matter at the Orakai Daehakro Hotel, Seoul, South Korea on December 18 – December 21, 2023.

PCS Seminars

"Magnetizing a BCS superconductor by spin-dependent tunneling"
by Mats Jonson, University of Gothenburg, Sweden (October 5)

"Controlling Quantum Computers for Computational Advantage"
by A. Barış Özgüler, University of Wisconsin–Madison, USA (October 10)

"Transport regimes for exciton-polaritons in disordered microcavities"
by Alexey Osipov, ITMO University, Russia (October 17)

"What Is the Next Milestone for High-Energy Particle Colliders?"
by Michael Peskin, Stanford University, USA (October 19), *IBS Physics Colloquium @ Daejeon*

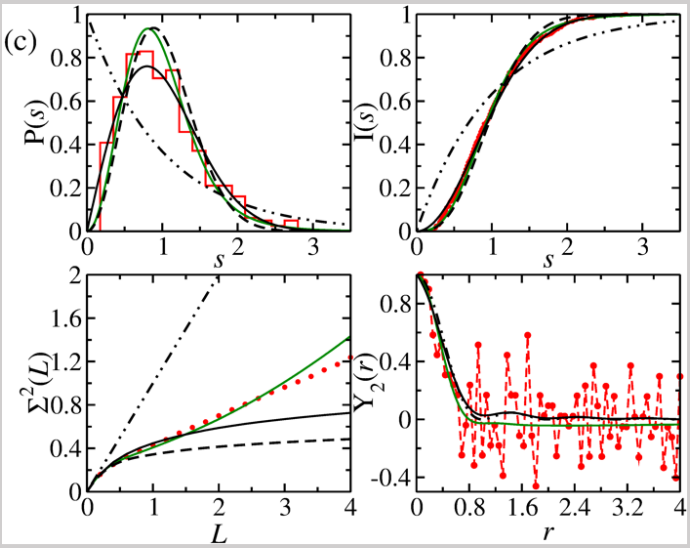
"Towards a more feasible implementation of quantum networks"
by Nicoló Lo Piparo, Okinawa Institute of Science and Technology, Japan (October 24)

"Quasiparticle interference of Gapped Dirac cones in thin film topological insulator"
by Alireza Akbari, Max Planck Institute for Chemical Physics of Solids, Germany (October 30)

"Analytical approaches for disordered Bose-Hubbard model at fixed filling"
by Manjari Gupta, Harish-Chandra Research Institute, Allahabad, India (October 31)

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

New Research Results



Experimental test of the Rosenzweig-Porter model for the transition from Poisson to Gaussian unitary ensemble statistics

Xiaodong Zhang, Weihua Zhang, Jiongning Che, and Barbara Dietz

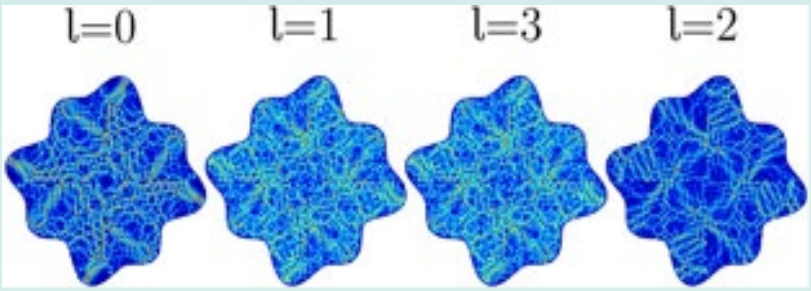
Phys. Rev. E 108, 044211 (2023)

The authors report on high-precision measurements that were performed with a flat superconducting microwave resonator with circular shape in which T-invariance violation and chaoticity were induced by magnetizing a ferrite disk placed at its center, which acts as a random potential. The authors determine a complete sequence of ~ 1000 eigenfrequencies and find good agreement with analytical predictions for the spectral properties of the Rosenzweig-Porter model, which interpolates between Poisson statistics expected for typical integrable systems and Gaussian unitary ensemble statistics predicted for chaotic systems with violated T invariance. Furthermore, the authors combine the RP model and the Heidelberg approach for quantum-chaotic scattering to construct a random-matrix model for the scattering matrix of the corresponding open quantum system and show that it perfectly reproduces the fluctuation properties of that of the microwave resonator.

Graphene billiards with fourfold symmetry

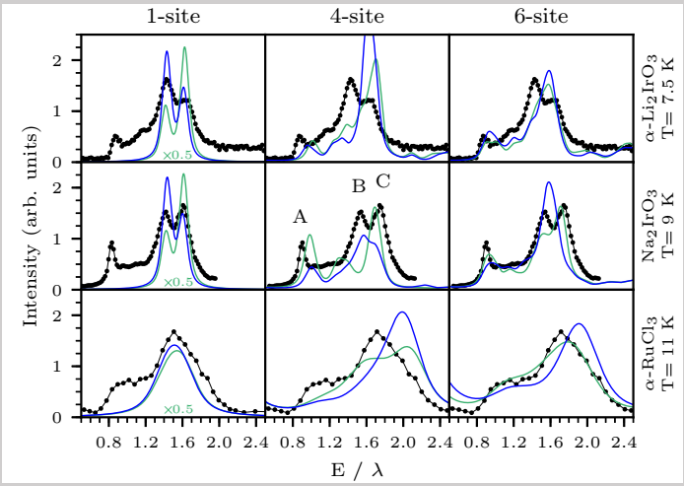
Weihua Zhang and Barbara Dietz

Phys. Rev. Research 5, 043028 (2023)



The authors report on the realization of a graphene billiard with a fourfold rotational symmetry with chaotic classical dynamics. The eigenstates are separated according to their transformation properties under rotation by 90° into four symmetry classes. These subspectra can be divided into regions around the band edges, where they are governed by the nonrelativistic Schrödinger equation, and a region of low energy-excitations around zero energy, that exhibit a linear dispersion relation and are described by the relativistic Dirac equation for a spin-1/2 quasiparticle. In both regions the spectral properties are conform with those of nonrelativistic quantum billiards of corresponding shape. In the relativistic region the momentum distributions in quasi-momentum space are localized at or near the 12 Dirac points at the corners of two hexagons that are rotated by 30° with respect to each other.

New Research Results



Nonlocal features of the spin-orbit exciton in Kitaev materials

Blair W. Lebert, Subin Kim, Beom Hyun Kim, Sae Hwan Chun, Diego Casa, Jaewon Choi, Stefano Agrestini, Kejin Zhou, Mirian Garcia-Fernandez, and Young-June Kim

Phys. Rev. B 108, 155122 (2023)

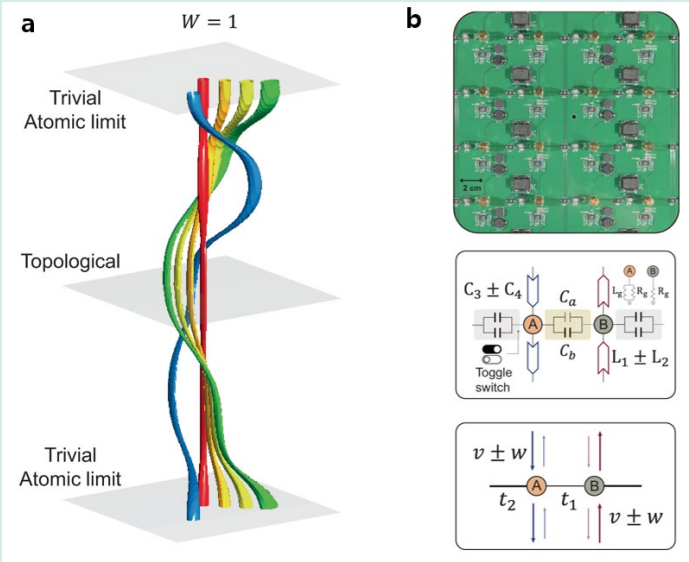
A comparative resonant inelastic x-ray scattering (RIXS) study of three well-known Kitaev materials is presented: α-Li2IrO3, Na2IrO3, and α-RuCl3. The RIXS spectra show remarkably similar three-peak features of three materials. Comparison of experimental spectra with cluster calculations reveals that the observed three-peak structure reflects the significant role that nonlocal physics plays in the electronic structure of these materials while spin-orbit assisted Mott insulator is still the best description for these materials.

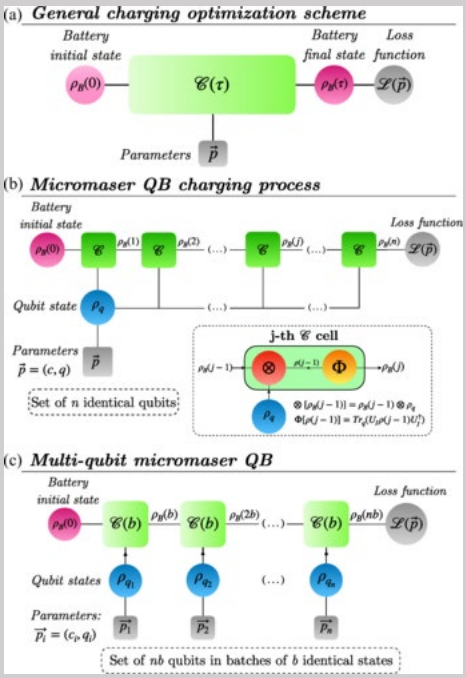
Realization of non-Hermitian Hopf bundle matter

Yung Kim, Hee Chul Park, Minwook Kyung, Kyungmin Lee, Jung-Wan Ryu, Oubo You, Shuang Zhang, Bumki Min, and Moon Jip Park

Communications Physics 6, 273 (2023)

The authors attempt to explore the non-Hermitian Hopf bundle by visualizing the global linking structure of spinor strings in the momentum space of a two-dimensional electric circuit. By exploiting the flexibility of reconfigurable couplings between circuit nodes, they study the non-Hermitian topological phase transition by exploring the intricate structure of the Hopf bundle. Furthermore, the authors find that the higher-order skin effect in real space is accompanied by the linking of spinor strings in momentum space, revealing bulk-boundary correspondence between the two domains.





Artificial intelligence discovery of a charging protocol in a micromaser quantum battery

Carla Rodríguez, Dario Rosa, and Jan Olle

Phys. Rev. A 108, 042618 (2023)

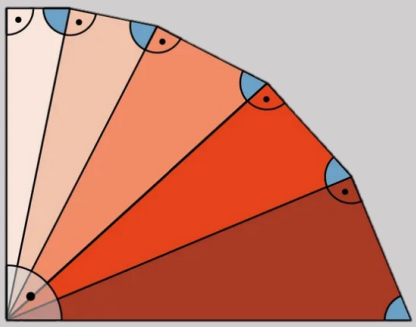
The authors propose a gradient-based general framework for optimizing the choice of external parameters in quantum batteries (QB). The framework is highly versatile and efficient, and it can be applied to very diversified scenarios in quantum thermodynamics. When applied to the specific case of micromaser quantum batteries, it leads to discover a new charging protocol for stabilizing the battery in upper-laying Hilbert space chambers in a controlled and automatic way.

Puzzle of the Month

October puzzle answer:

we finally got one answer, but that one was not correct, as it predicted that John will win.
The solution is that the Mary always wins. She just has to make sure that the sum of marbles John took before her move and her current move equals exactly 10 or 20. That's easily possible - if John1 takes 1, Mary takes 9, J(9) M(1), J(4) M(16) and J(16) M(4).

Puzzle of the month:



What's the sum of the blue angles?

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