PCS NEWSLETTER

QR to PCS Webpage

August 2023

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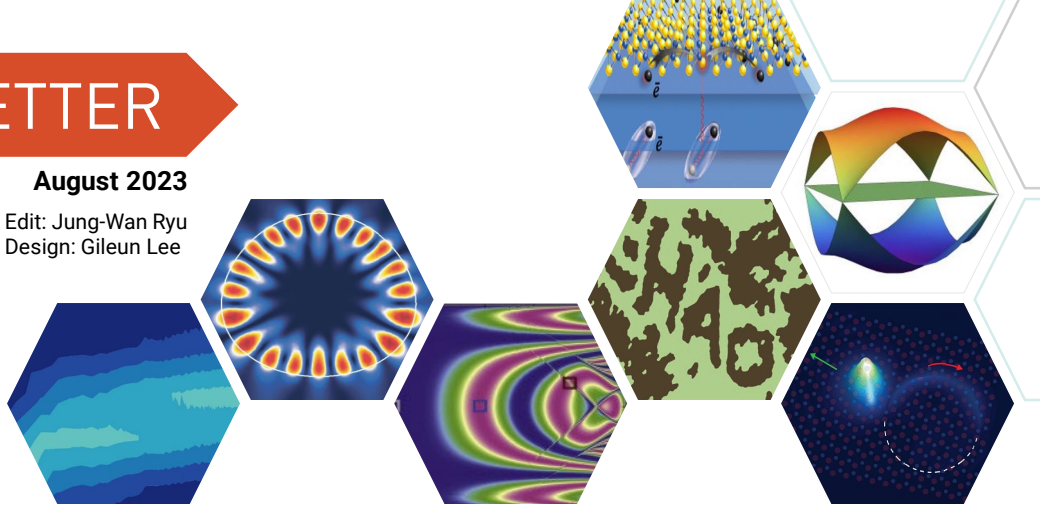
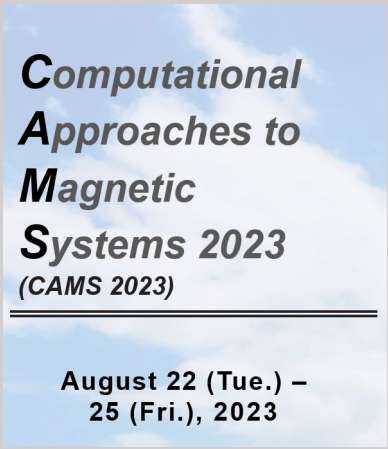
Design: Gileun Lee



PCS Workshops and Meetings

PCS will co-host *IBSPCS-APCTP International Workshop Computational Approaches to Magnetic Systems (CAMS-2023)* at the Asia Pacific Center for Theoretical Physics (APCTP) on August 22 – August 25, 2023.



PCS IBS Seminars

"Quantum-classical entangled approach with tensor networks for spin liquid"
by Tsuyoshi Okubo, University of Tokyo, Japan (July 13)

"Fine-grained complexities in parameterized quantum circuits"
by Chae-Yeun Park, Xanadu, Canada (July 14)

"Variational Quantum Algorithms for the Geometric Measure of Entanglement"
by Leonardo Zambrano, The Institute of Photonic Sciences, Spain (July 18)

"Chaos and Relaxation in a Dissipative Sachdev-Ye-Kitaev Model"
by Jacobus Verbaarschot, Stony Brook University, USA (July 19)

"Machine Learning in Particle and String Theory"
by Andre Lukas, University of Oxford, UK (July 20), *IBS Physics Colloquium @ Daejeon*

"Klein bottle partition function and tensor networks"
by Hong-Hao Tu, Technische Universität Dresden, Germany (July 20)

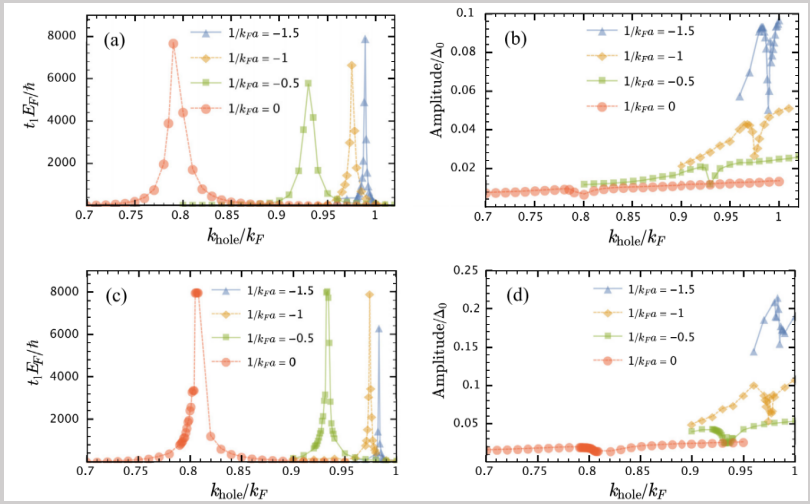
You can find more seminars on ***this page***.

New Research Results

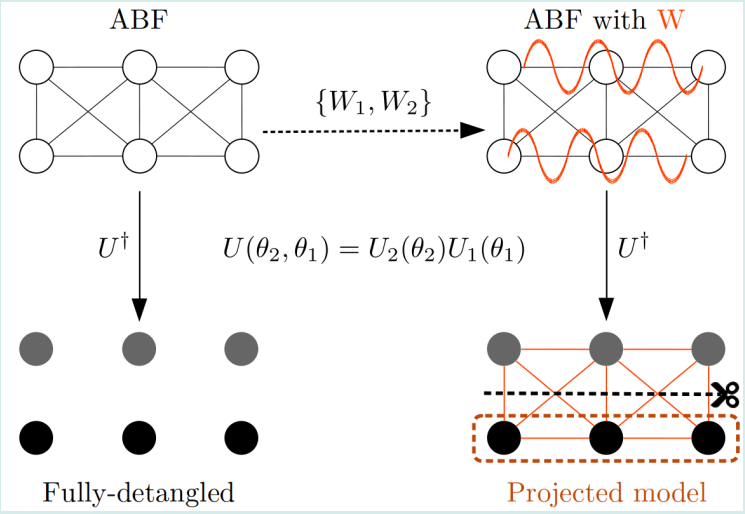
Exciting the long-lived Higgs mode in superfluid Fermi gases with particle removal

Guitao Lyu, Kui-Tian Xi, Sukjin Yoon, Qijin Chen, and Gentaro Watanabe

Phys. Rev. A 107, 023321 (2023)



The authors study how to excite long-lived Higgs-mode oscillations in a homogeneous superfluid Fermi gas in the BCS-BEC crossover. The authors find that the Higgs mode can be excited by time-periodically modulating the scattering length at an appropriate amplitude and frequency. However, even for a modulation frequency below twice the pairing-gap energy, quasiparticles are still excited through the generation of higher harmonics due to nonlinearity in the superfluid. More importantly, they find that persistent Higgs-mode oscillations with almost constant amplitude can be produced by removing particles at an appropriate momentum, and the oscillation amplitude can be controlled by the number of removed particles. Finally, the authors propose two ways to experimentally realize particle removal.



Critical state generators from perturbed flatbands

S. Lee, S. Flach, and Alexei Andreanov

Chaos 33, 073125 (2023)

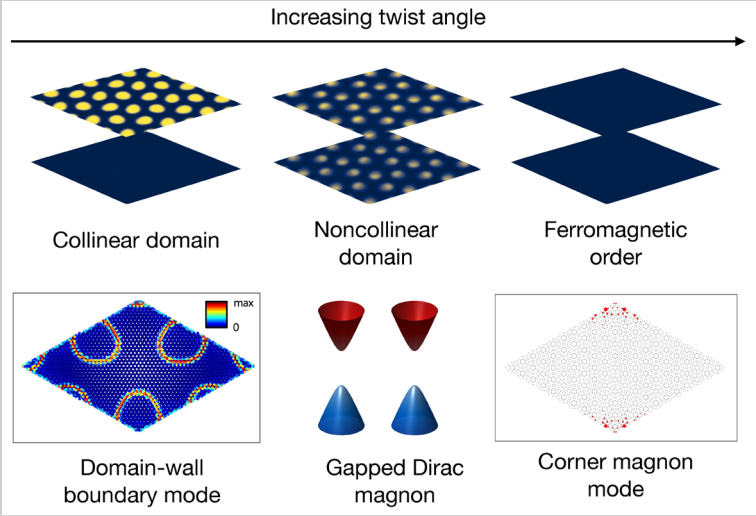
The breaking of the macroscopic degeneracy in lattice systems allows to realize a variety of interesting and exotic phases depending on the types of the perturbation applied. One particular example of macroscopic degenerate systems is all-bands-flat systems where all energy bands are flat. In this work, the authors considered the full manifold of all-band-flat systems to complete the understanding of the effect of the quasiperiodic perturbations. The authors analytically identified extra submanifolds with critical eigenstates for weak potential strengths. For finite strengths, they confirmed numerically the emergence of tunable critical-to-insulator transitions (CITs) and fractality edges (energy-dependent CITs) on these submanifolds. In all other cases, the perturbed Hamiltonians turned out to have all their eigenstates localized.

New Research Results

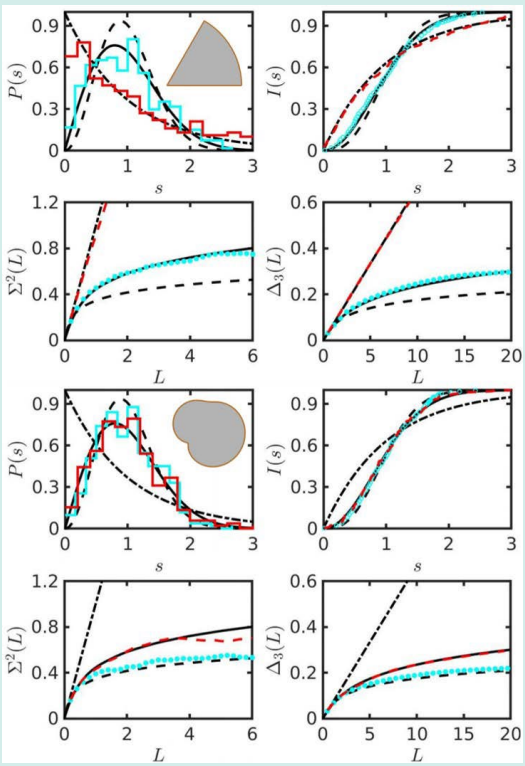
Ab Initio Spin Hamiltonian and Topological Noncentrosymmetric Magnetism in Twisted Bilayer CrI3

Kyoung-Min Kim, Do Hoon Kiem, Grigory Bednik, Myung Joon Han, and Moon Jip Park

Nano Lett. 23, 6088−6094 (2023)



Twist engineering in van der Waals magnets has emerged as a novel platform for exploring unique magnetic phenomena in the magnetic moiré superlattice. However, previous research has been limited to investigating the magnetic structures, which is only a fraction of the boundless possibilities in this field. In this study, the authors aimed to overcome this limitation by developing a comprehensive and efficient theoretical framework for investigating moiré magnetism in twisted magnets. Firstly, based on first principles calculations, the authors devised a method to construct atomistic spin Hamiltonians that accurately and effectively handle the complex magnetic interactions within the superlattice. Additionally, they pioneered the development of a theory that describes the unique critical phenomena and the topological bands of moiré magnons in twisted magnets. Furthermore, they were the first to reveal that non-centrosymmetric magnetism, such as the skyrmion lattice, and topological phenomena like higher-order-topological and magnonic Chern insulators, can manifest in magnetic systems through twist engineering.



Time-reversal invariance violation and quantum chaos induced by magnetization in ferrite-loaded resonators

Weihua Zhang, Xiaodong Zhang & Barbara Dietz

Eur. Phys. J. Spec. Top. (2023)

The authors investigate the fluctuation properties in the eigenfrequency spectra of flat microwave cavities that are homogeneously filled with ferrite, which is magnetized with an external magnetic field perpendicular to the resonator plane. These studies were motivated by experiments in which small pieces of magnetized ferrite were embedded in the cavity to induce partial time-reversal (T) invariance violation. The authors show that in the frequency region, where the two-dimensional Helmholtz equation applies, the magnetization of the ferrites has no effect on the wave dynamics and does not induce T-invariance violation. In contrast, in the three-dimensional case, T invariance is violated and, independently of the shape of the cavity, a chaotic wave dynamics is induced in the sense that the spectral properties coincide with those of quantum systems with a chaotic classical dynamics.

Puzzle of the Month

July puzzle answer:

4,59 + 4,95 = 9,54 ! Congratulations to Sergei Koniakhin, whose answer came in almost instantly!

But then, there is also

4,05 + 0,45 = 4,50
4,50 + 0.54 = 5,04 ! Congratulations to Alireza Akbari for finding these solutions!

Puzzle of the month:

a) Clara has two kids - and one of them is a boy. What is the probability that the second child is a boy as well?
b) Clara has two kids - and one of them is a boy. But now we also learn, that that boy was born on a Tuesday. What is then the probability that Clara has two boys?

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