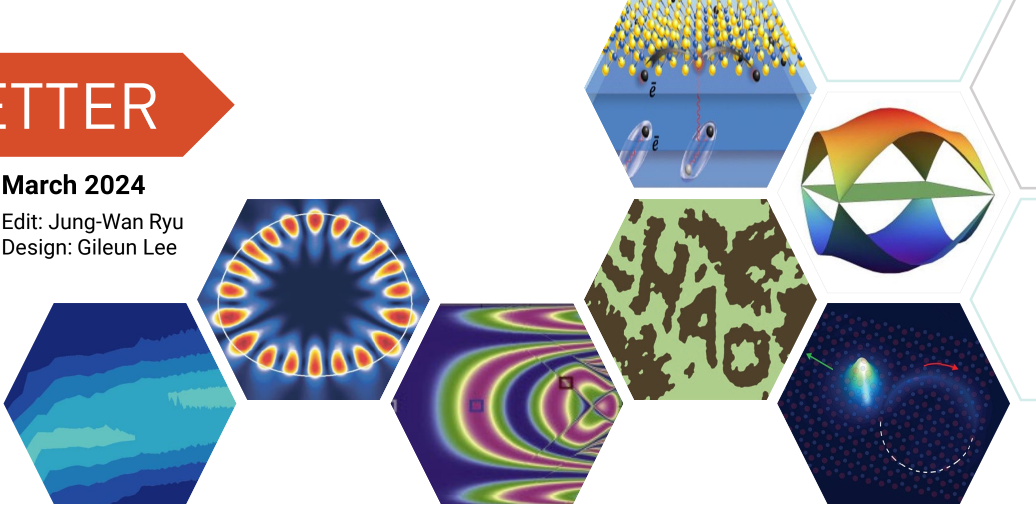
PCS NEWSLETTER

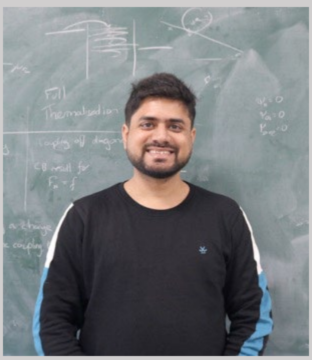
March 2024

Edit: Jung-Wan Ryu
Design: Gileun Lee

QR to PCS Webpage



New members



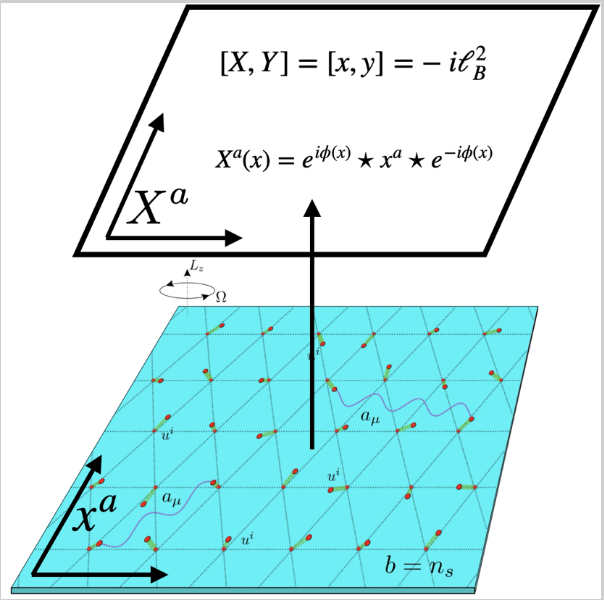
Dr. Rohit Kishan Ray has joined PCS as a post-doctoral fellow. He has completed his PhD at the Indian Institute of Technology Kharagpur. He has experience in steepest entropy ascent formalism, a nonlinear thermodynamic model of dissipation in quantum systems. Currently, he is interested in Many-Body Localization problems, thermalization, and Flat-Bands. He is also interested in work extraction in quantum systems.

PCS IBS Seminars

"Coulomb blockade in a non-thermalised quantum dot"
by Rose Davies, Aston University, UK (February 8)

"From waves to chaotic flows in the cytoplasm"
by Lara Koehler, MPIPKS, Germany (February 22)

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



Noncommutative field theory of the Tkachenko mode: Symmetries and decay rate

Yi-Hsien Du, Sergej Moroz, Dung Xuan Nguyen, and Dam Thanh Son

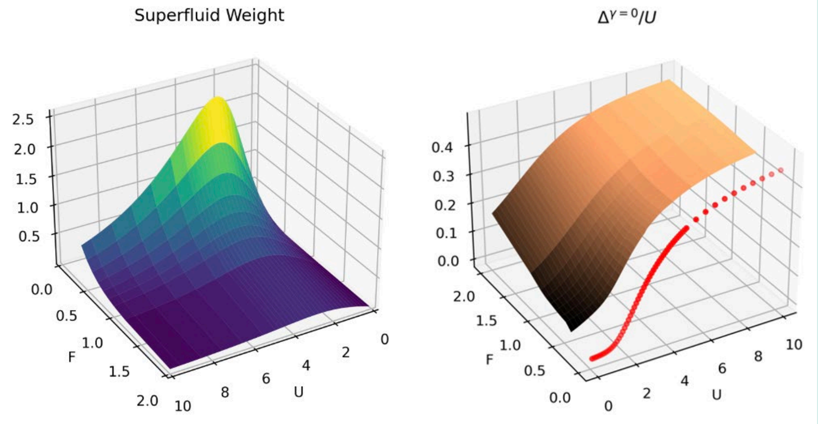
[Phys. Rev. Research Letters 6, L012040 (2024)]

The Tkachenko wave is a special phonon of the superfluid vortex lattice with a quadratic dispersion; it is a shared Nambu-Goldstone boson of magnetic translation and boson conservation symmetries. A nonlinear theory of the Tkachenko mode based on noncommutative field theory with the dipole symmetry is formulated, and it is shown that the excitation is stable.

Superconductivity with Wannier-Stark flat bands

Si Min Chan, Alexei Andreanov, Sergej Flach, and G. George Batrouni

[Phys. Rev. B 109, 075153 (2024)]



The authors investigate superconducting transport in the DC field induced Wannier-Stark flat bands in the presence of interactions. Flat bands offer the possibility of unconventional high temperature superconductivity, where the superfluid weight is enhanced by the density overlap of the localized states. However, construction of flat bands typically requires very precise tuning of Hamiltonian parameters. To overcome this difficulty, the authors propose a feasible alternative to realize flat bands by applying a DC field in a commensurate lattice direction. The main result is that the superfluid weight is dramatically enhanced at an optimal value of the interaction strength and weak DC fields.

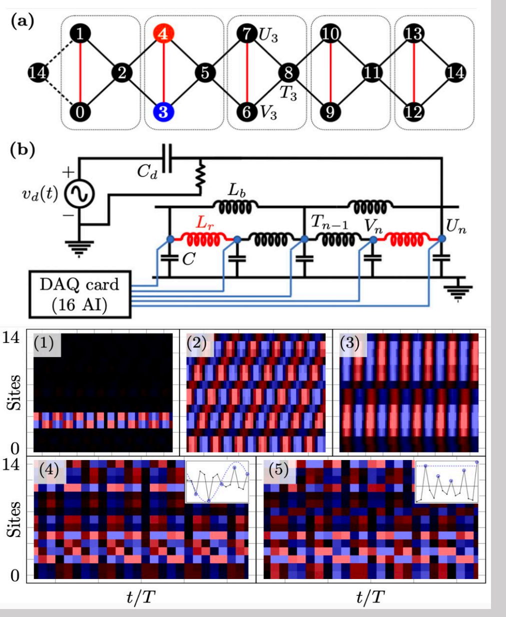
New Research Results

Compact localized states in electric circuit flat-band lattices

Carys Chase-Mayoral, L. Q. English, Noah Lape, Yeongjun Kim, Sanghoon Lee, Alexei Andreanov, Sergej Flach, and P. G. Kevrekidis

[Phys. Rev. B 109, 075430 (2024)](#)

The authors generate compact localized states (CLSs) in an electrical diamond lattice composed of inductors and capacitors, by locally driving with flatband frequency. The authors compare experimental results to numerical simulations and find very good agreement. They also introduce lattice nonlinearity and showcase the realization of nonlinear compact localized states in the diamond lattice. The findings pave the way of applying flatband physics to complex electric circuit dynamics.



Puzzle of the Month

February puzzle solution: 6

The gardener found n^3 seeds, where n is the number of new plants, i.e., a positive integer. Thus, we want to find n^3 mod 7 for integer n. Modular arithmetic preserves integer scaling, and thus exponentiation. So (n = m) mod 7 => ($n^3 = m^3$) mod 7. Thus, we can find the possible values of remnant seeds by calculation n^3 mod 7 for n = 1, 2, …, 7. We get 1→1, 2→1, 3 → 6, 4 → 1, 5 → 6, 6 → 6, 7 → 0. Among the possible values, {0, 1, 6}, only 6 can be referred to as "a few". So, the answer is 6.

This correct solution was sent by Ihor Vakulchyk. Congratulations!

Puzzle of the month:

Three new friends meet in a cafe and exchange their six digit local phone numbers (no area code, so the first digit cannot be zero!).

One of them makes an interesting observation - if each of the three numbers is permuted by chopping off the last two digits and gluing them to the left (say abcdef is permuted into efabcd), then each permuted number is three times larger than its original nonpermuted partner.

Can you tell the original phone numbers?

Send your solution to eun@ibs.re.kr

The winner will be announced in the next issue.