PCS NEWSLETTER

QR to PCS Webpage

February 2023

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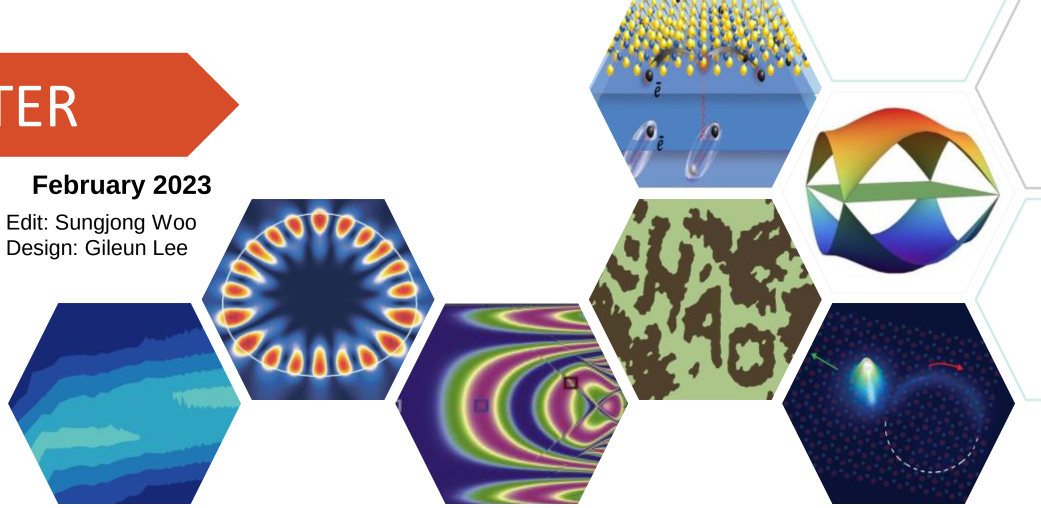


PCS IBS Seminars

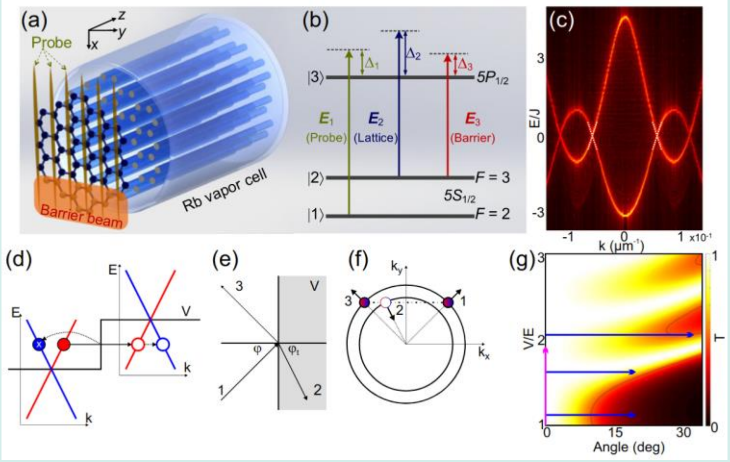
"Nonlinear spectroscopy of spin chains"
by Gibaik Sim, Technische Universitat Munchen, Germany (January 6)

"Global phase diagram of charge neutral graphene in the quantum Hall regime for generic interactions"
by Suman Jyoti De, Harish-Chandra Research Institute, India (January 17)

"Neural Quantum States approach to the study of volume law ground states"
by Giacomo Passetti, Aachen University, Germany (January 26)

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

New research results



Angular-Dependent Klein Tunneling in Photonic Graphene

Zhaoyang Zhang, Yuan Feng, Feng Li, Sergei Koniakhin, Changbiao Li, Fu Liu, Yanpeng Zhang, Min Xiao, Guillaume Malpuech, and Dmitry Solnyshkov

Phys. Rev. Lett. 129, 233901 (arXiv:2112.03066)

Photonic graphene analog based on honeycomb lattice created in the Rb atoms vapor cell using the electromagnetically induced transparency (EIT) effect is powerful battleground for investigation of such experimentally difficult accessible areas as relativistic physics, quantum electrodynamics and topological physics. The addressed in present research Klein paradox consists in the perfect tunneling of relativistic particles through high potential barriers. Being a curious feature of particle physics, it is responsible for the exceptional conductive properties of graphene. This study reports the first experimental observation of perfect Klein transmission in photonic graphene at normal incidence and measurement the angular dependence. Counter-intuitively, but in agreement with the Dirac equation, the authors observe that the decay of the Klein transmission versus angle is suppressed by increasing the barrier height, a key result for the conductivity of graphene and its analogues.

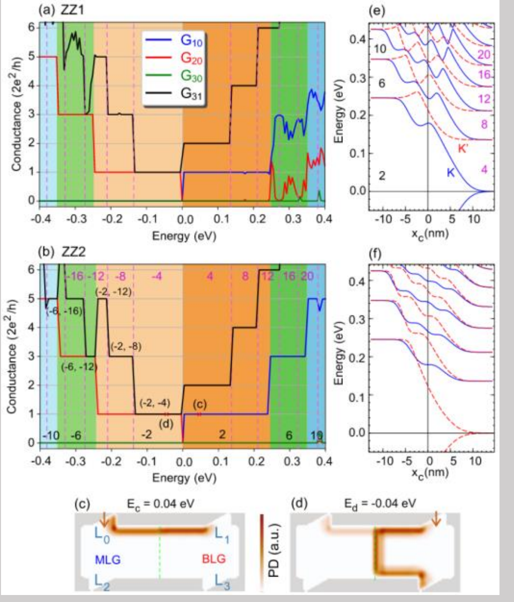
New research results

Electronic Mach-Zehnder interference in a bipolar hybrid monolayer-bilayer graphene junction

M. Mirzakhani, N. Myoung, F.M. Peeters and H.C. Park

Carbon 201, 734-744(arXiv:2205.12508)

In this work, the authors demonstrate that an n-p junction of monolayer-bilayer graphene (MLG-BLG) interface bar in the Hall regime results in valley-polarized edge-channel interference and can function as a fully tunable Mach-Zehnder (MZ) interferometer device. Their findings show that the MZ interference in such structures can be drastically affected by the type of (zigzag) edge termination of the second layer in the BLG region. Such a natural junction between MLG and BLG in the QH regime can be a promising platform for studying electron interference associated with valley-polarized edge channels. Two possible areas of electron-interferometry research are fractional and non-Abelian statistics and quantum entanglement via two-particle interference.

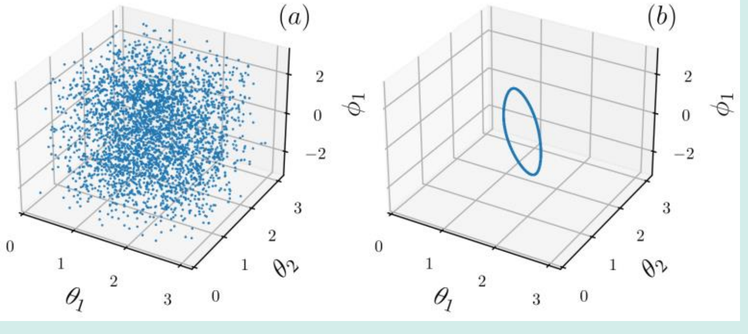


Entanglement Dynamics and Classical Complexity

Jiaozi Wang, Barbara Dietz, Dario Rosa and Giuliano Benenti

Entropy 2023, 25(1), 97 (arXiv:2211.11213)

The authors study the dynamical generation of entanglement for a model of two interacting rotors. They show analytically that – in the quasiclassical regime – the entanglement growth rate can be computed by means of the underlying classical dynamics. Furthermore, this rate is given by the Kolmogorov–Sinai entropy, used to characterize the dynamical complexity of classical motion. In this way, they establish in the quasiclassical regime a direct link between the generation of entanglement, a purely quantum phenomenon, and classical complexity.

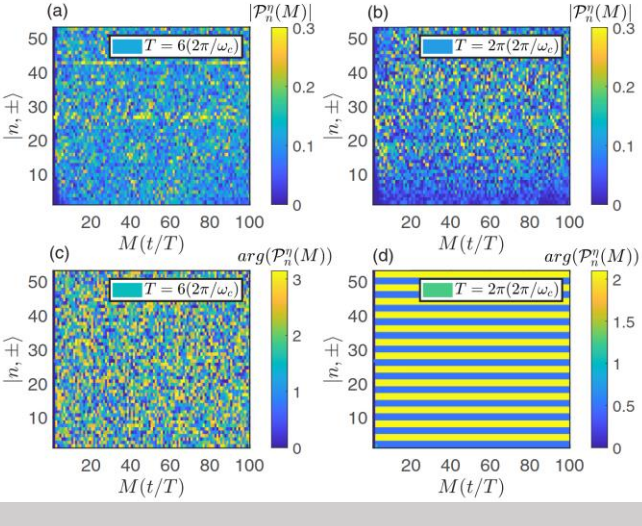


Role of chiral symmetry in a kicked Jaynes-Cummings model

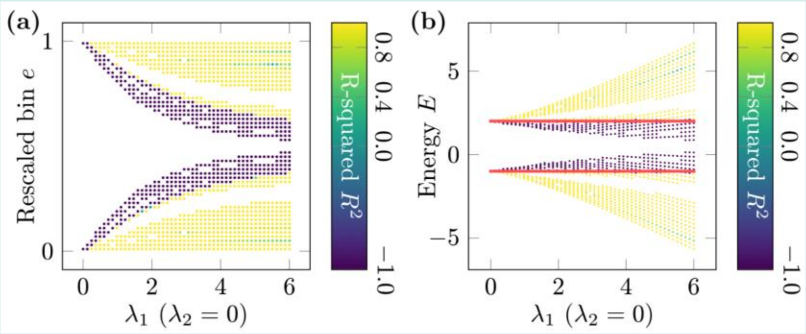
Pinquan Qin and Hee Chul Park

Phys. Rev. A 107, 013712 (arXiv:2112.03066)

The authors have studied the role of chiral symmetry in a periodically kicked Jaynes–Cummings (KJC) model by freezing an initial phase. The chiral symmetry is conserved or not depending on the periodicity of kicks, commensurate or not. The chiral symmetry preserves the phase of an initial state against phase fluctuations during the dynamical evolution, but broken chiral symmetry erases the initial phase. The frozen phase is preserved within a finite evolution time for slight deviations of the kick period from an integer multiple of 2π and small variations of detuning from the resonant condition. The chiral symmetry-protected phase information is noteworthy as it provides various uses in quantum computation and information.



New research results



Critical-to-insulator transitions and fractality edges in perturbed flat bands

Sanghoon Lee, Alexei Andreanov, and Sergej Flach

Phys. Rev. B 107, 014204
(arXiv:2208.11930)

In the past decades, systems featuring macroscopic degeneracy have attracted a lot of attention due to their extreme sensitivity to peturbations. The class of systems that draws attention is that with flat energy bands, and the breaking of its macroscopic degeneracy allows us to realize exotic phases for different types of perturbation. In this work, the authors studied the influence of a quasiperiodic perturbation on a one-dimensional all-bands-flat system, where all energy bands are flat. By varying the parameters of the quasiperiodic potentials, they observe localized insulating states and an entire parameter range hosting critical states with subdiffusive transport in the weak perturbation. The critical-to-insulating transition becomes energy dependent for the finite perturbation, which the authors call "fractality edges" separating localized from critical states.

Puzzle of the month

December-January puzzle answer:

Backwards, unless. The pedal trajectory when biking is qualitatively similar to the trajectory of a point on some inner part of the wheel - say at half radius or similar. It is a kind of smoothened cycloid. The cycloid you usually get as the trajectory of a point on the outer part of the wheel, and it has a singularity at the moment when the point is touching the ground. A smoothened curve is the one where this singularity is - well - smoothened, making the curve a kind of distorted but still analytic periodic curve. Despite the bottom positioned pedal going back relative to the biker while biking, it still goes forward in the frame of an outside observer standing on the street. So, pulling the rope backwards will make the bike roll backwards, and forward - forward. Unless. If you manage to have a bike with an insane gear ratio (say close to the situation where you have to make zillions of pedal rotations for just a tiny move of the bike) then the answer be opposite - pulling the rope backwards will move the bike forward. Which also tells you that there must a special gear where the pedal trajectory is an exact cycloid, and the answer to the above question becomes tricky. Still, almost all (if not truly all) bikes have gear ratios which are such that the bike will move backwards.

The correct answer came from Sungjong Woo - congratulations!

Puzzle of the month:

100 boxes numbered from 1 to 100. We fill one box with one orange, another with two, another with three, and so on until the last one gets exactly 100 oranges. But in a random way, so there is no correlation between the box number and the orange number. Your task is to find the box with 38 oranges. You have to open a box, check the number of oranges, and if it is not 38, close the box, and open another one. What is the best strategy to find the box with 38 oranges with the smallest number of box openings?

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