PCS NEWSLETTER

October 2022

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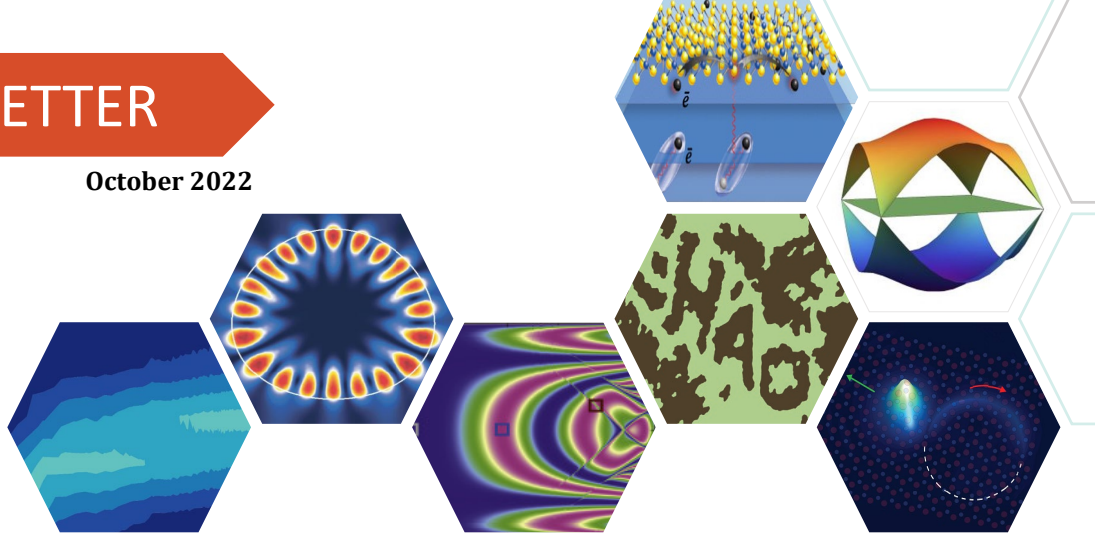


PCS Workshops and Meetings

PCS, with the Asia Pacific Center for Theoretical Physics, successfully hosted *IBS-APCTP Conference on Advances in The Physics of Topological and Correlated Matter* September 19 - 23, 2022. We enjoyed 32 invited talks on-site as well as through on-line and 17 posters with 124 participants.

PCS will host *Dynamics Days Asia Pacific (DDAP12)* on Nov 7 - 11, 2022. To apply for participation, complete the online application form by October 16, 2022.

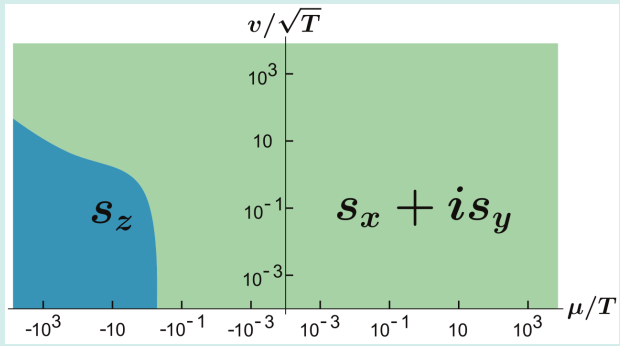
New research results

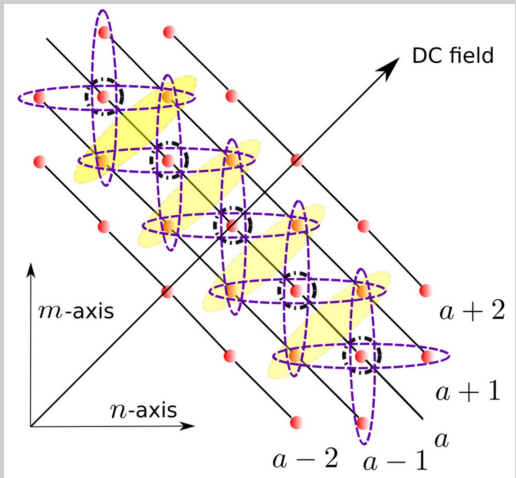
Topological triplet-superconductivity in spin-1 semimetal

GiBaik Sim, Moon Jip Park and SungBin Lee

Communication Physics **5**, 220

Fermi statistics is the governing rule of superconductivity that intertwines the orbital and the spin character of the cooper pair. In this work, the authors focus on the superconductivity of the effective spin-1 fermions. This new type of band crossing leads to unconventional superconductivity, where the electrons follow the effective Bose statistics. They claim that such superconductivity uniquely stabilizes spin-triplet pairing. Unlike conventional superconductors and other multi-band superconductors, such triplet superconductivity is the novel phenomenon of triple point fermions where spin-singlet pairing is strictly forbidden in the on-site interaction due to the Fermi statistics.





Correlated metallic two-particle bound states in Wannier-Stark flatbands

Arindam Mallick, Alexei Andreanov, and Sergej Flach

Phys. Rev. B 106, 125128 (arXiv:2204.12652)

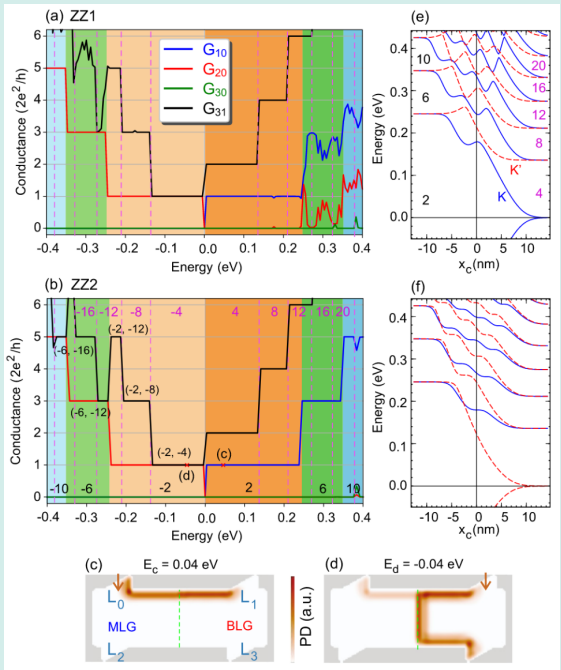
Whenever a DC field is applied to a square lattice (in almost any direction) the resulting tight-binding Hamiltonian with a nearest-neighbor hopping has a spectrum composed of an infinite tower of flatbands. Consequently any particle transport in the system is suppressed. The authors consider two particles with on-site interaction placed in the Wannier-Stark flatbands on a square lattice: how would this perturbation affect the transport properties of the system? They demonstrate analytically and numerically, that the local interaction induces transport of pairs, that depends nontrivially on the direction of applied field.

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

Mohammad Mirzakhani, Nojoon Myoung, Francois M. Peeters and Hee Chul Park

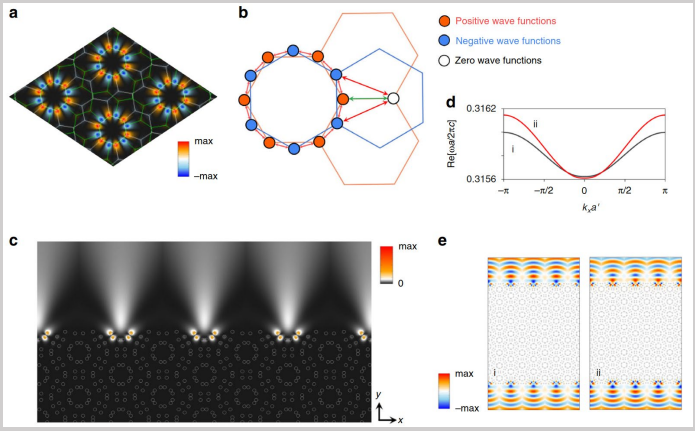
Carbon 201, 734-744

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 to study 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.



New research results

Strong interlayer coupling and stable topological flat bands in twisted bilayer photonic Moiré superlattices
Chang-Hwan Yi, Hee Chul Park, and Moon Jip Park
Light: Science & Applications 11, 289
The authors study the topological flat bands in a twisted bilayer photonic moiré superlattices in the strong interlayer coupling regime. Because of its great advantage in wide tunability, the moiré superlattices pave the way for designing a new class of materials. Their results show that the observed flat bands are characterized by a non-trivial band topology under the strong interlayer coupling, the origin of which is the moiré patterns. In addition, they show that the first-order topological edge modes naturally deform into higher-order topological corner modes when the reflection symmetry is broken. This work is expected to pioneer the physics of topological phases beyond the weakly coupled regime in the designable platform of photonic moiré superlattices.



Puzzle of the month

September puzzle answer:

320 tons. Say the first three wagons have masses a, b, c with $a + b + c = 430$. Then wagon nr 4 again has mass a, nr 5 b, etc. So the mass distribution is abcabcabc…a since there are 40 wagons, it follows $a = 5700 - 13 \times 430 = 110$. And therefore $b + c = 430 - 110 = 320$. The two middle wagons have numbers 20, 21 and therefore mass b and c. The final answer is 320 tons.

Congratulations to Amnon Aharony (Tel Aviv) for the correct answer!

Puzzle of the month:

A math professor writes a long natural number on the blackboard. Then she counts the students loud through, from 1 to 200. All students memorize their own number. Now the professor is asking each student - in the order of their count number - to tell whether the long number on the blackboard is divisible by that student count number or not. The first student in the front row at the left corner starts and says ‘yes’. No surprise, his number was ‘1’. What then follows is a series of ‘yes’, with only two ‘no’s - with the second ‘no’ coming right after the first ‘no’. Then and until 200 again only ‘yes’ answers follow.
What are the student count numbers of the students who answered with the two ‘no’s?

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