PCS NEWSLETTER

QR to PCS Webpage

May 2023

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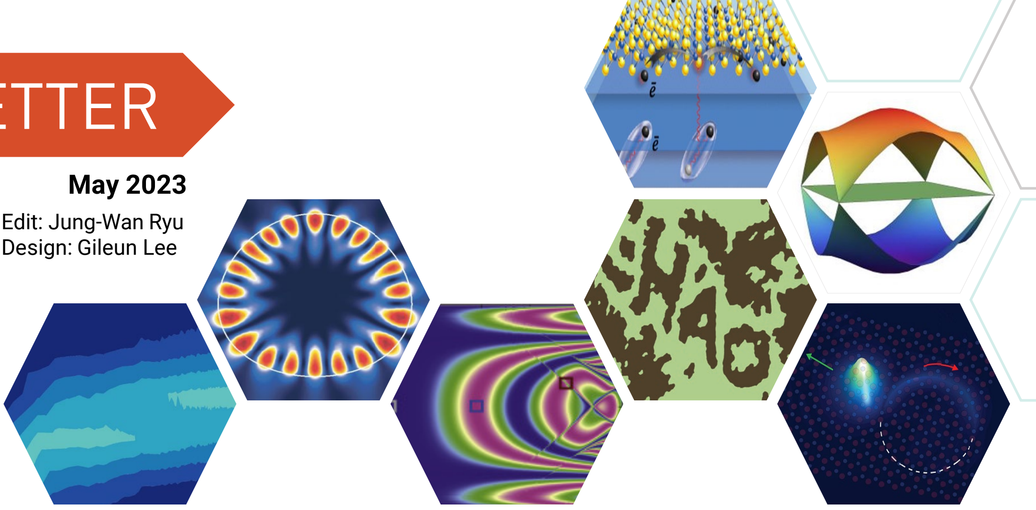


PCS IBS Seminars

"Extending quantum operations of fixed-frequency superconducting qubits"
by Yosep Kim, Korea Institute of Science and Technology, Korea (April 4)

"Coherent tunneling of Josephson vortices"
by Alexey Ustinov, Karlsruhe Institute of Technology, Germany (April 5)

"Slowing down microwave photons with superconducting qubits"
by Alexey Ustinov, Karlsruhe Institute of Technology, Germany (April 6)

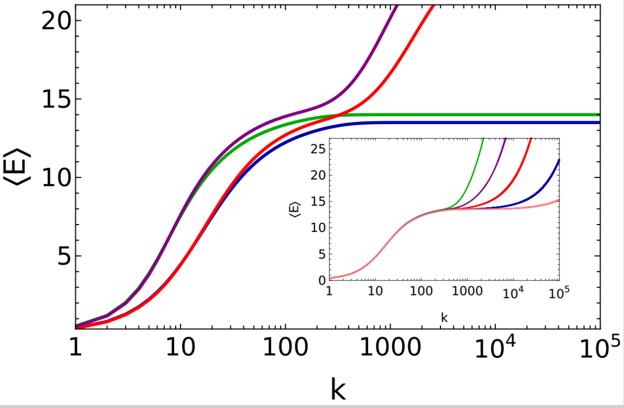
"Anomalous Skin Effects in Disordered Systems with a Single non-Hermitian Impurity"
by Paolo Molignini, Stockholm University, Sweden (April 13)

"How strong can the electron-phonon interaction in metals be?"
by Boris Altshuler, Columbia University, USA (April 27)

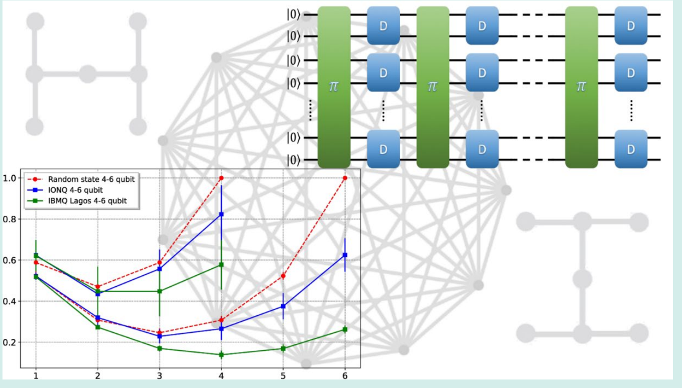
You can find more seminars on ***this page***.

New Research Results

Lossy Micromaser Battery: Almost Pure States in the Jaynes–Cummings Regime
Vahid Shaghaghi, Varinder Singh, Matteo Carrega, Dario Rosa and Giuliano Benenti
Entropy 25(3), 430 (2023)
The authors re-consider a micromaser model of a quantum battery, including in the model the presence of cavity losses, described by a Lindblad master equation. They show that battery performances, in terms of stored energy, charging power, and steady-state purity, are slightly degraded up to moderated dissipation rate. Their results show that micromasers are robust and reliable quantum batteries, thus making them a promising model for experimental implementations.



New Research Results

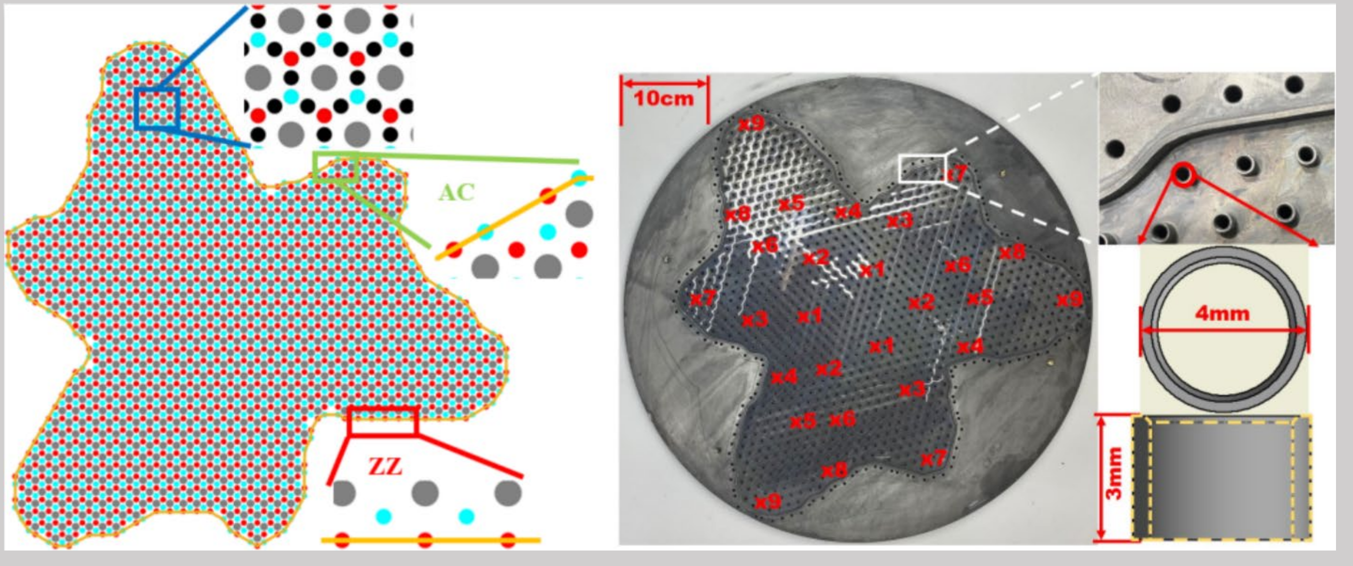


Generation of Pseudo-Random Quantum States on Actual Quantum Processors

Gabriele Cenedese, Maria Bondani, Dario Rosa and Giuliano Benenti

[*Entropy 25*(4), 607 (2023)]

The generation of a large amount of entanglement is a necessary condition for a quantum computer to achieve quantum advantage. The authors propose a method to efficiently generate pseudo-random quantum states, for which the degree of multipartite entanglement is nearly maximal. They use this method to benchmark actual superconducting (IBM's ibm_lagos) and ion trap (IonQ's Harmony) quantum processors, finding a better performance of the ion trap quantum processor. They link such a result to the all-to-all connectivity of qubits in this architecture.



Properties of eigenmodes and quantum-chaotic scattering in a superconducting microwave Dirac billiard with threefold rotational symmetry

Weihua Zhang, Xiaodong Zhang, Jiongning Che, Maksym Miski-Oglu, and Barbara Dietz

Phys. Rev. B **107**, 144308 (2023)

The authors report on experimental studies that were performed with a microwave Dirac billiard, that is, a flat resonator containing metallic cylinders arranged on a triangular grid, whose shape has a threefold rotational C3 symmetry. Its band structure exhibits two Dirac points (DPs) that are separated by a nearly flat band. They present a procedure which allows to classify the eigenstates according to their transformation properties under rotation by 2p/3 into the three C3 subspaces and demonstrate that the properties of the eigenmodes coincide with those of artificial graphene around the lower DP, and are well described by a tight-binding model for a honeycomb-kagome lattice of corresponding shape. Furthermore, they investigate properties of the wave-function components in terms of the measured scattering matrix and develop a random-matrix model for quantum-chaotic scattering systems exhibiting extended or localized states in the interaction region. Even in regions, where the wave functions are localized, the spectral properties coincide with those of typical quantum systems with chaotic classical counterpart.

Puzzle of the Month

April puzzle answer:

we got quite some dynamics with answer emails. Some initially assumed that the weights are always on one weighing dish, and the unknown mass on the other. If so, the simplest solution is six weights 1,2,4,8,16,32 (i.e. powers of 2), which was correctly stated by Aniket Patra. Then, realizing that weights can be placed on both weighing dishes, with the unknown mass on one of them, Aniket reduced the number of weights to 5: 3,4,5,10,20 (and Sanawaz Alam submitted another version with 1,5,7,27,40). However, one can do better: powers of 3, i.e. four weights 1,3,9,27. Test it, it works. Why? Take one weight, it has three states: in the left, in the right, or in none. So with n weights you have 3^n combinations. Remove the empty one (none of all weights on any of the dishes) and you have $3^n - 1$ relevant combinations. But only half of them are irreducible, because of the left right symmetry. So the final number of combinations you can come up with is $(3^n - 1)/2$. With n=4 you get exactly 40 combinations. Therefore n=3 will not work as it produces only 13 combinations.

Congratulations to Aniket Patra and Sanawaz Alam who got closest to the solution.

Puzzle of the month:

When you accelerate a car, the front goes up, and the back down. When you brake, the opposite happens. Why? Can you construct a car which does everything the other way around?

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