

HATANO LAB.

Connecting Microscopic and Macroscopic Physics

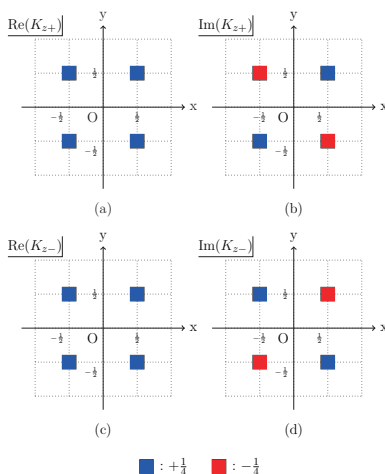


Large-scale experiment and advanced-analysis platform (LEAP)

Quantum Thermodynamics and Statistical Physics

Department of Physics, Graduate School of Science

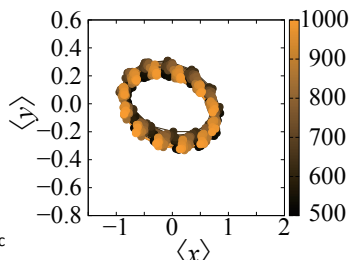
<http://hatano-lab.iis.u-tokyo.ac.jp/>



The uncertainty principle defies joint description of multiple quantum observables. This motivated the introduction of complex-valued 'quasi-probabilities' to account for their virtual joint behavior.

Our laboratory proposed several criteria for their usefulness based on a unified theory of quantizations and quasi-probabilities. Among various candidates, the Kirkwood-Dirac distribution (left) is found to be favored in terms of faithfulness and affinity to classical theory.

(Shun Umekawa, Jaeha Lee, and Naomichi Hatano, Prog. Theor. Exp. Phys., Vol. 2024, No 023A02, 2024.)



Quantum walk is handy to simulate physics in relativistic regions. It was known that the 1D quantum walk is equivalent to a 1D Dirac particle but a 2D quantum walk that is equivalent to a 2D Dirac particle has not been known.

Our laboratory found such a quantum walk for the first time in the world. The 2D model successfully exhibits an elliptic dynamics in a harmonic potential (upper right) and the spectrum of a topological insulator (lower right).

(Manami Yamagishi, Naomichi Hatano, Ken-Ichiro Imura and Hideaki Obuse, Physical Review A, Vol. 107, No. 042206, 2023.)

