# N. Hatano LAB.

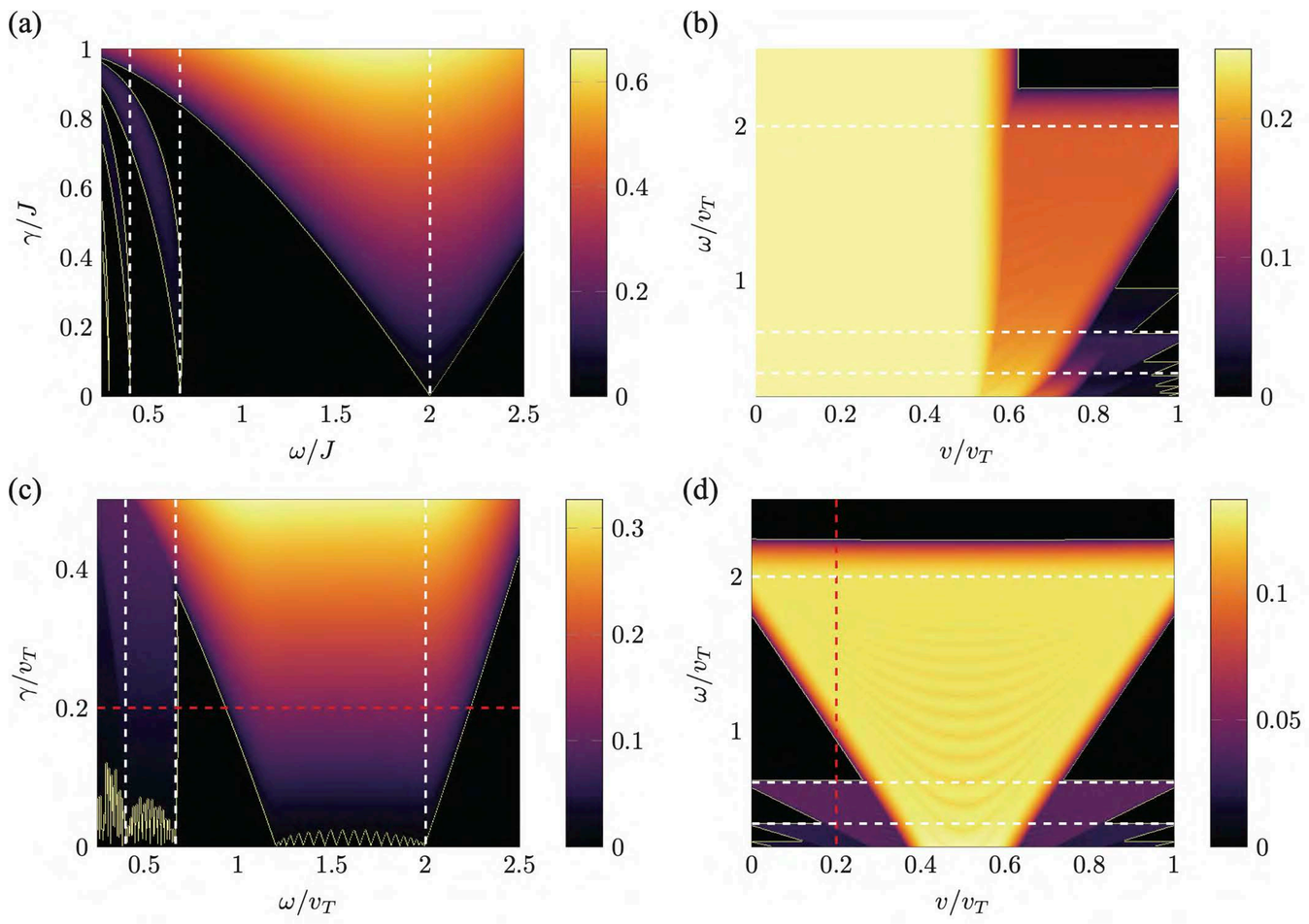
## [Quantum Mechanics and its Applications]

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

Quantum Thermodynamics and Statistical Physics

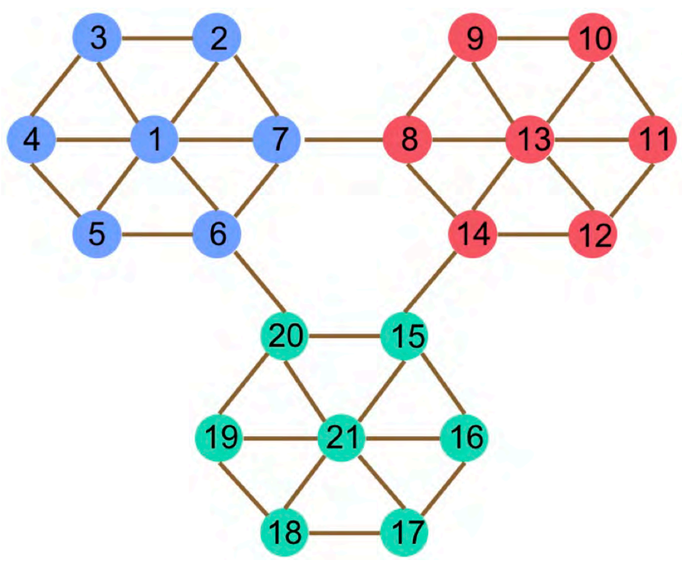
Department of Physics, School of Science

http//hatano-lab.iis.u-tokyo.ac.jp/




It is widely believed that the Hamiltonian operator, which gives a real-valued energy, should have the property called the Hermiticity. In recent years, however, studies on its non-Hermitian extension are attracting much attention. Our laboratory promote the non-Hermitian quantum mechanics, which Hatano initiated in 1996.

Non-Hermitian operators can have real eigenvalues and complex ones. We can control the appearance of real eigenvalues by tuning parameters and time-dependence of the Hamiltonian operator. The figure on the left shows that the region in which all eigenvalues are real (the black area) can change according to the parameter variation. (Andrew K. Harter and Naomichi Hatano)




Networks that surround us can have hubs and communities. It has been studied intensively as a difficult problem to detect communities from given data of networks.

Our laboratory succeeded in community detection by using a quantum walk, which is a quantum version of a random walk. From a prototypical network on the above to the U.S. airport network, we showed a quantum walker is localized in each community; see the figure on the right. (Kanae Mukai and Naomichi Hatano, Physical Review Research)