

HATANO LAB.

Connecting Microscopic and Macroscopic Physics

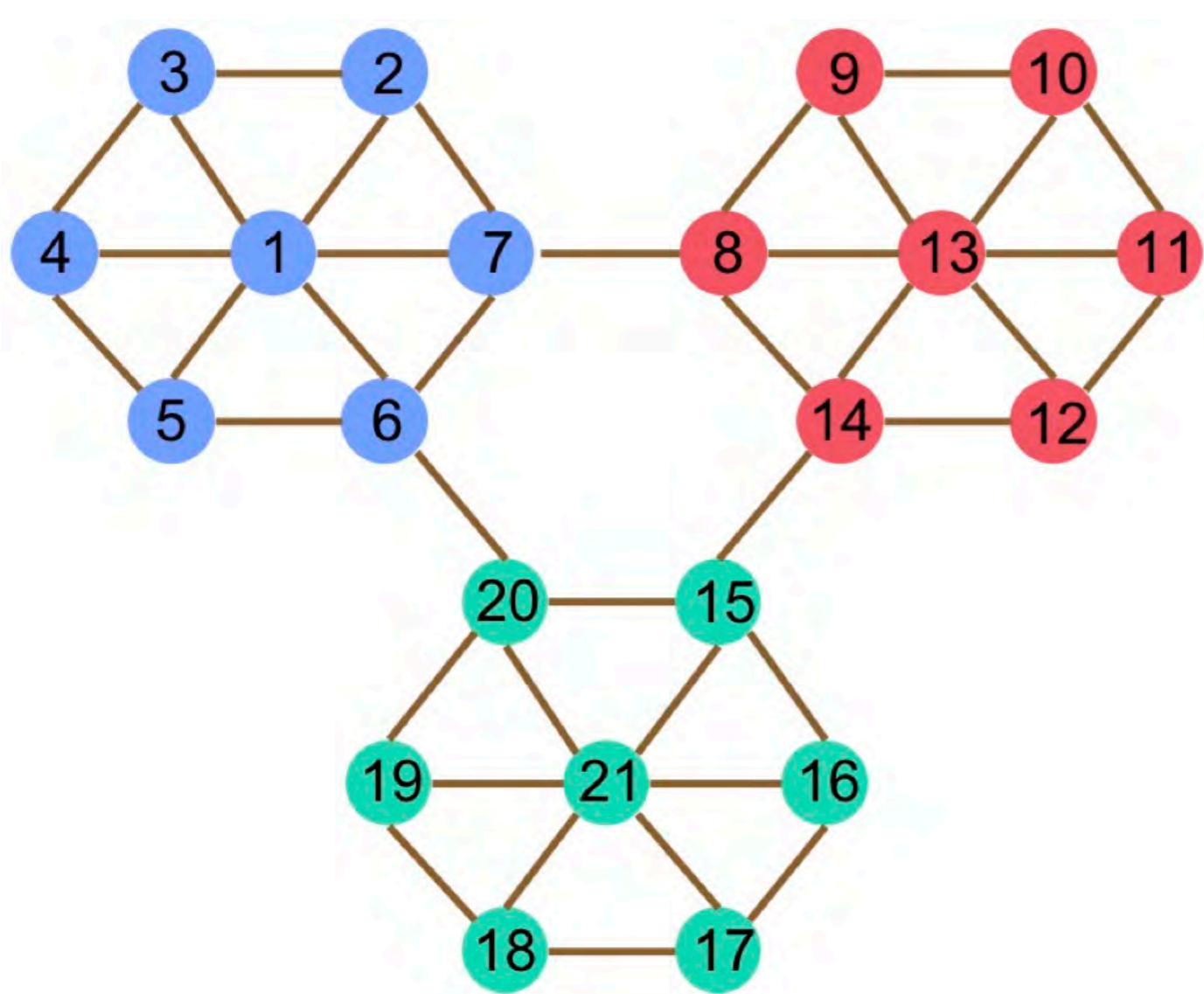


Large-scale experiment and advanced-analysis platform (LEAP)

Quantum Thermodynamics and Statistical Physics

Department of Physics, Graduate School of Science

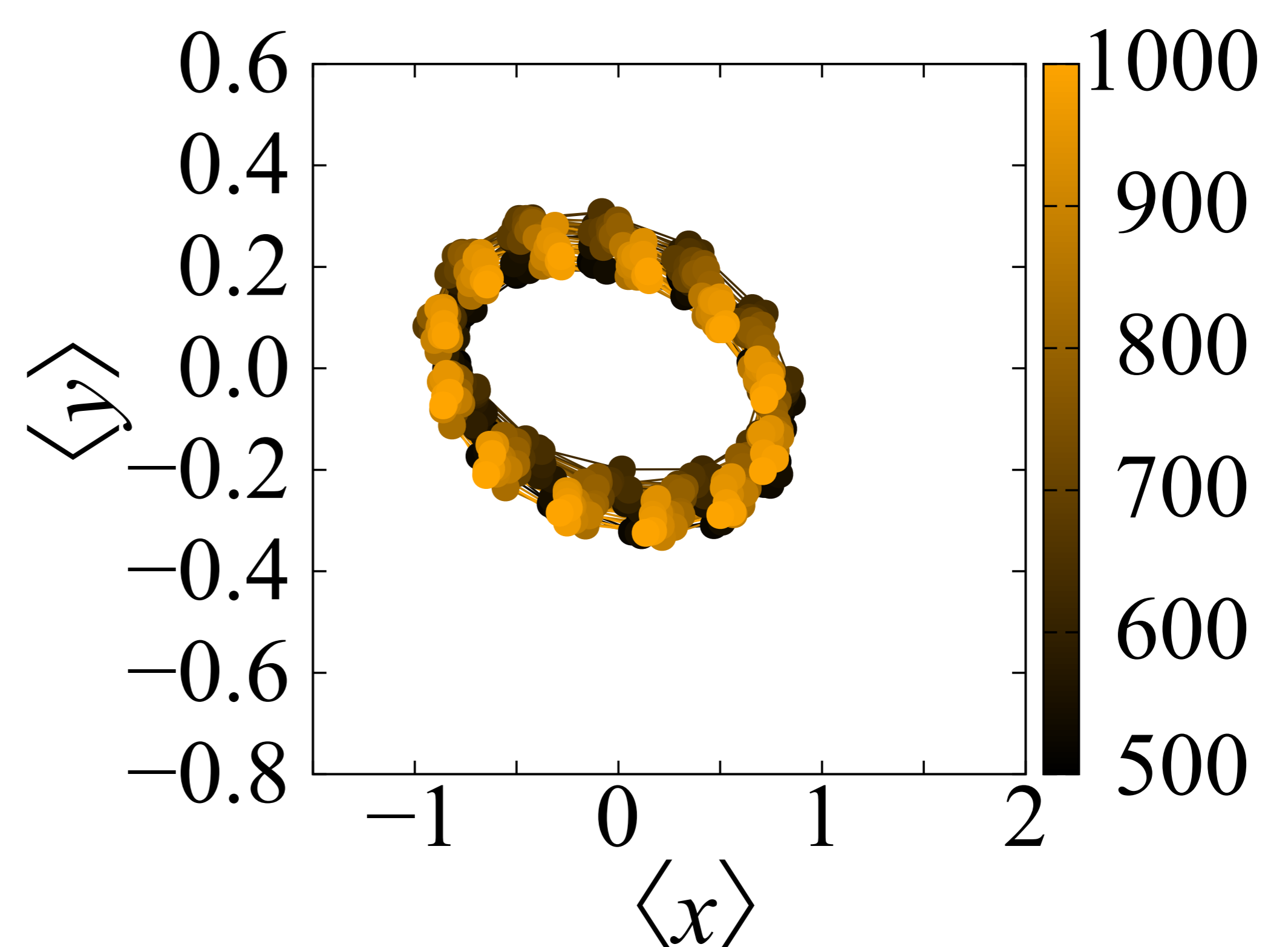
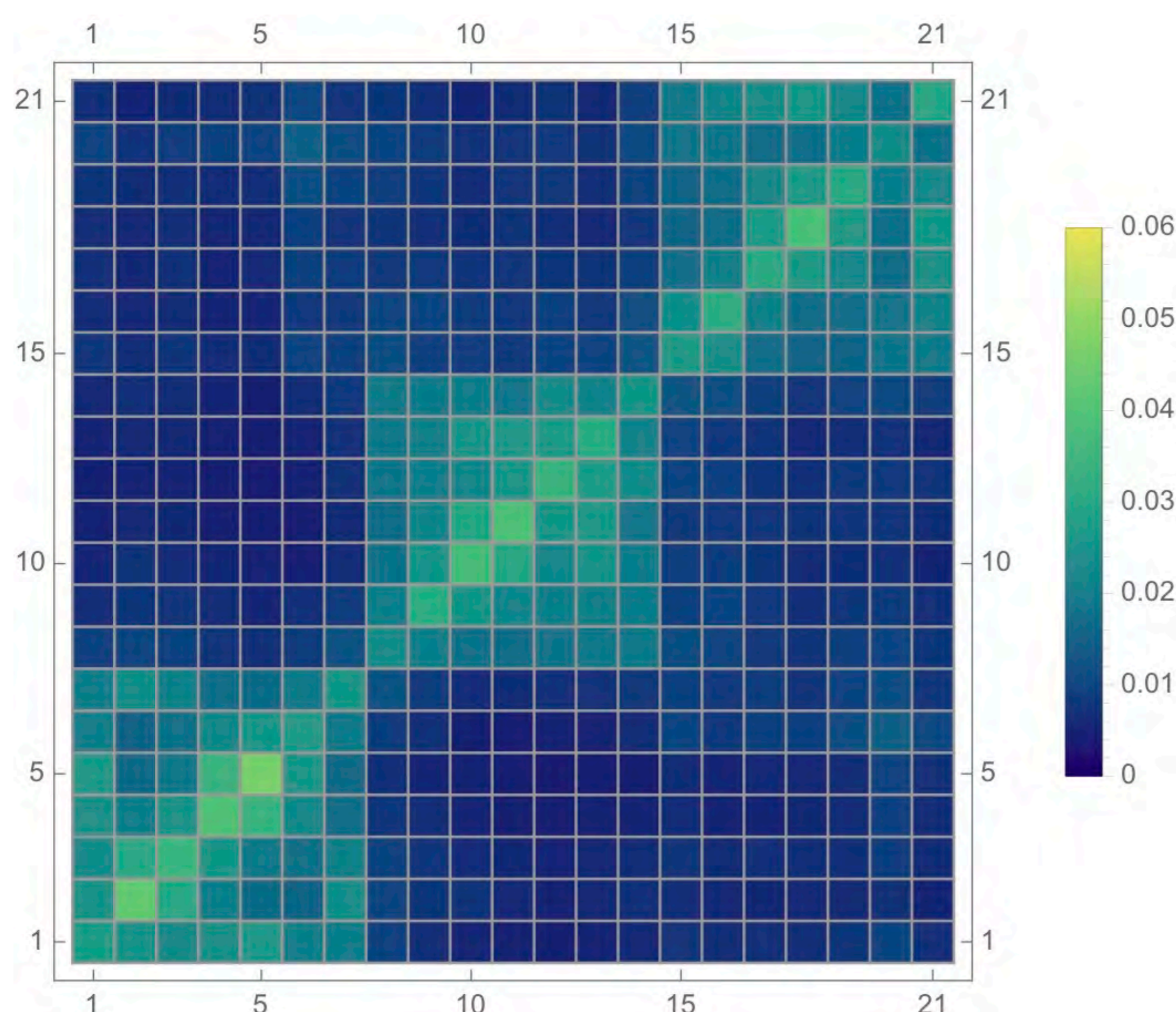
<http://hatano-lab.iis.u-tokyo.ac.jp/>



Networks that surround us can have hubs and communities (a.k.a. clusters). 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 upper-left figure to the U.S. airport network, we showed a quantum walker is localized in each community; see the figure on the lower left.

(Kanae Mukai and Naomichi Hatano, Physical Review Research, Vol. 2, No. 023378, 2020))



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.)

