ERATO Sagawa Information-to-Energy Interconversion Project

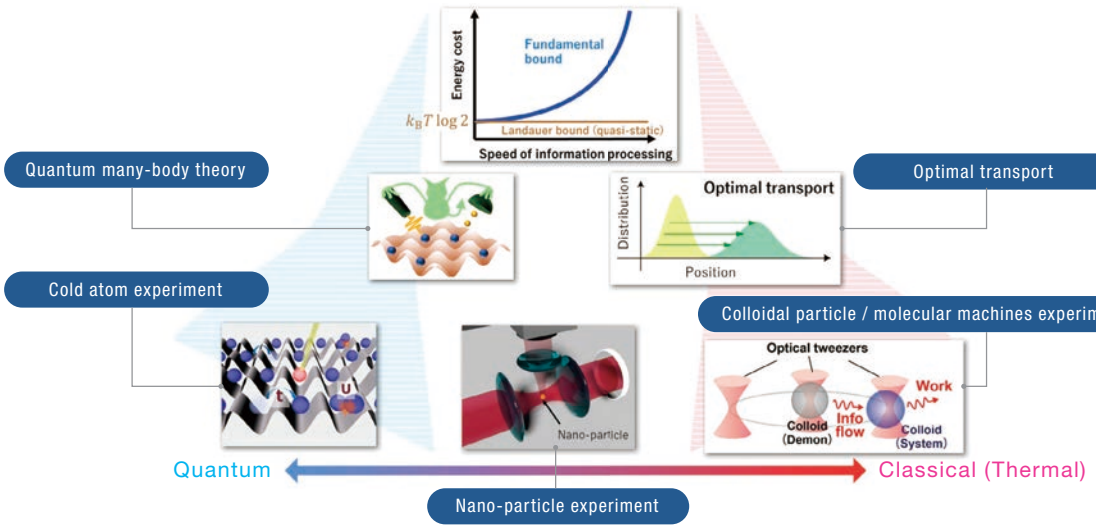
Project Website
https://www.jst.go.jp/erato/sagawa/en/

Since the proposal of the paradox of Maxwell's daemon in the 19th century, the relationship between information and thermodynamics has been a topic of long controversy in physics. Today, not only has it been shown that the demon and the second law of thermodynamics are consistent when information entropy is taken into account, but also advances in the theory of nonequilibrium statistical mechanics and experimental control techniques at the level of thermal fluctuations have shed new light on information thermodynamics in the last 15 years. By focusing on information processing in finite time and information thermodynamics in quantum many-body systems, this project aims to reveal the fundamental limit of the interconversion of information and thermodynamic energy from both theoretical and experimental perspectives.

Research Director
SAGAWA Takahiro
University of Tokyo
Professor

[Overview]

Currently available computers consume much more energy than the fundamental bound, and the increase in energy consumption associated with computation is a serious problem.
This Research Project sets the problem of how to simultaneously achieve fast information processing and high energy efficiency, which are in a trade-off relationship. The research will be conducted both theoretically and experimentally from the perspective of thermodynamics of information, which has been pioneered by the Research Director. Specifically, we will establish a theory of the fundamental bound of energy required for fast information processing. Experimentally, interconversion between information and thermodynamic energy will be verified through control of thermal and quantum fluctuations. The obtained results would lead to new design principles of computers in the future.



Establish the fundamental bound of information-to-energy interconversion

ERATO Sagawa Information-to-Energy Interconversion Project

Research Groups / Group Leader

Information thermodynamics theory group

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Superconducting quantum circuit experiment team

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Optimal transport theory group

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Quantum many-body theory group

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Molecular-machine experiment group

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Nanoparticle experiment group

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2024-10-00