Interdisciplinary Physics Research Based on Quantum Information Theory

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Keywords	Statistical physics (13010), Fundamental theory of condensed matter physics (13010), Mathematical physics (13010), Quantum information physics (13010), Magnetism (13030), Strongly correlated electron systems (13030), Superconductivity (13030), Quantum fluids and solids (13030)

Research Topics

- Reconstruction of renormalization group theory by singular value decomposition
- Information-geometrical analysis of gauge/gravity correspondence
- Tensor network approach to various physical problems
- Composite operator approach to strongly correlated electron systems

Research Seeds

(1) ***Interdisciplinary physics research based on quantum information theory***

In recent years, information-theory-oriented approaches have become quite powerful at forecasting common mathematical structures inherent in many branches of theoretical physics. Based on this fascinating concept, I am working on various problems, particularly addressing the quantum/classical correspondence in terms of quantum data storage into curved memory space. I am also interested in singular value decomposition and its application to statistical physics. To proceed with research efficiently, I am corroborating with many researchers within and beyond Japan. I am also proceeding to publish specialized textbooks in addition to original research papers.

(2) ***Composite operator approach to strongly correlated electron systems***

Magnetism and superconductivity are two major research topics in condensed matter physics. These phenomena sometimes originate from strong electron correlation, which drastically changes non-interacting band dispersion of electrons. We analyze the deformed band structure in terms of the composite operator approach, which can detect how electrons are dressed with non-local magnetic fluctuation. The detection naturally elucidates the understanding of the mechanism of nontrivial magnetism and high-Tc superconductivity.

Related Technology

- super-parallel computation techniques realized in K computer
- lecture of information physics based on my textbook