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論文審査の結果の要旨および担当者

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論　文　題　目

Quantum resource theories from the viewpoint of statistical decision theory

（統計的決定理論の観点に基づく量子リソース理論）

論文審査担当者

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論文審査の結果の要旨

During the past decade, combined efforts from the public and private sectors all over the world moved quantum information technologies, like quantum cryptography and quantum computation, out of experimental laboratories into commercially available products. Such a shift has had effects also on the theoretical side of research. Many "quantum phenomena" that before were understood as mere features of the theory are now considered as genuine resources to be harnessed and used to speed up calculations or guarantee unbreakable encryptions. The mathematical theories that characterize and quantify such quantum resources are collectively known as "quantum resource theories".

ZHOU Wenbin's PhD thesis titled "Quantum resource theories from the viewpoint of statistical decision theory"（統計的決定理論の観点に基づく量子リソース理論）, is focused on two important aspects of quantum resource theories: on the one hand, the concrete setup of programmable quantum measurement processes; on the other hand, the abstract formulation of general quantum resource theories in terms of statistical decision problems and convex optimization (semidefinite linear programming).

The thesis is organized as follows. After an initial part (Chapter 1-3) in which the notation is introduced and background literature is reviewed (including some relevant technical results like the Blackwell-Sherman-Stein Theorem and Shannon's ordering of noisy channels), Chapter 4 introduces the notion of programmable quantum measurements and their pre- and post-processing transformations. In the spirit of quantum decision theory, everything is formulated in terms of (quantum) statistical games, and as a result quantum programmability is identified as a resource equivalent to quantum communication. Chapter 5 formulates semidefinite linear programs to quantify the "amount of quantum programmability" available in any given measurement device. Chapter 6 moves onto a more abstract scenario, in which resources are identified with the elements of an abstract finite-dimensional convex set. In this scenario, which comprises as special cases the theories of quantum entanglement and quantum coherence, relative Rényi entropies are used to introduce criteria to decide suitable preorders within the convex set of resources. Finally, Chapter 7 is devoted to exploring connections between ZHOU Wenbin's PhD research activities and 実世界データ循環学プログラム, of which he has been a member since the beginning of 博士課程前期.

The results summarized in this thesis led to two publications on international peer-reviews journals (one Physical Review Letters and one Journal of Physics A), two invited talks (hosted by the universities of Geneva and Cambridge), and one refereed contributed talk (hosted by the National Cheng Kung University in Taiwan).

Therefore, it has been judged that the submitter of the present thesis, ZHOU Wenbin, has achieved sufficient research records to be conferred the Doctor Degree (博士（情報学）の学位).