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【556】 General Quantum Resource Theories: Maximal Resources, Catalytic Replication, and Consistent Measures

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Quantum resource theories (QRTs) provide a unified framework for understanding quantum-mechanical properties, but physically well-motivated resources may possess structure whose analysis is mathematically intractable, such as **non-uniqueness of maximally resourceful states, non-convexity, and infinite-dimensionality**. We systematically study manipulation and quantification of resources in general QRTs under minimal assumptions. We prove general existence of maximally resourceful states. We also discover a novel phenomenon, **catalytic replication of resources**, where a resource state is infinitely replicable by free operations. Furthermore, we introduce and study notion of **consistent resource measures** to quantify resources without contradicting asymptotic-state-conversion rate. These establish unified foundation of QRTs applicable to physically well-motivated resources whose analysis can be mathematically intractable.

Author: YAMASAKI, Hayata

Co-author: KUROIWA, Kohdai

Presenter: YAMASAKI, Hayata

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