IRFU : Institut de recherche sur les lois fondamentales de l'univers

Saclay

LARSIM

Entropic measures of indefinite causality in quantum theory

Spécialité Physique théorique, mécanique quantique

Niveau d'étude Bac+5

Formation Master 2

Unité d'accueil LARSIM

Candidature avant le 01/09/2022

Durée 6 mois

Poursuite possible en thèse oui

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Résumé

Quantum advantages in quantum protocols arise from the use of superposition or entanglement. The discipline of quantum information has recently come to realize that quantum advantages can also be obtained via another fundamental physical principle: causality.

Sujet détaillé

Indefinite causal orders – a non-classical resource based on the indefinite nature of causal relations between operations in Hilbert space – provide a quantum advantage demonstrably different from that of superposition. Recent theoretical and experimental work has shown that causal indefiniteness – a new and experimentally relevant resource for quantum information processing tasks – can be characterized by a violation of a “causal inequality” analogous to the Bell inequality for quantum entanglement. We will study the entropic version of the causal inequality in analogy with the work of Fritz and Chaves on the entropic CHSH inequality. In particular, we will try to understand whether, contrary to a conjecture made in the literature, non-maximally causally indefinite quantum processes can violate an entropic inequality in the bipartite scenario.

Mots clés

Quantum information

Compétences

Stage théorique. Discussions et collaboration avec les équipes à l’Institut Néel (Grenoble).

Logiciels

Entropic measures of indefinite causality in quantum theory

Summary

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Full description

Indefinite causal orders – a non-classical resource based on the indefinite nature of causal relations between operations in Hilbert space – provide a quantum advantage demonstrably different from that of superposition. Recent theoretical and experimental work has shown that causal indefiniteness – a new and experimentally relevant resource for quantum information processing tasks – can be characterized by a violation of a “causal inequality” analogous to the Bell inequality for quantum entanglement. We will study the entropic version of the causal inequality in analogy with the work of Fritz and Chaves on the entropic CHSH inequality. In particular, we will try to understand whether, contrary to a conjecture made in the literature, non-maximally causally indefinite quantum processes can violate an entropic inequality in the bipartite scenario.

Keywords

Quantum information

Skills

Softwares