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

Saclay

LARSIM

Postquantum causality and its measures

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 focused mainly on a causally indefinite process called the “quantum switch” or a more general framework of “process matrices”. It has established causal indefiniteness as a new and exper-imentally relevant resource for quantum information processing tasks. By highlighting the role of information-theoretic postulates in axiomatizations of quantum theory, the framework of generalized probabilistic theories (GPT) provides significant insight into non-classical phe-nomena, such as nonlocality. During this internship, we will use the GPT framework to devel-op a model for maximally violating the causal inequality in a way that is analogous to the vio-lation of the Bell-CHSH inequality by the Popescu-Rohrlich boxes.

Mots clés

Quantum information

Compétences

Stage théorique. Discussions et collaboration avec les équipes à l’Inria Saclay, Institut Néel (Grenoble) et PCQC (Université de Paris).

Logiciels

Postquantum causality and its measures

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 focused mainly on a causally indefinite process called the “quantum switch” or a more general framework of “process matrices”. It has established causal indefiniteness as a new and experimentally relevant resource for quantum information processing tasks. By highlighting the role of information-theoretic postulates in axiomatizations of quantum theory, the framework of generalized probabilistic theories (GPT) provides significant insight into non-classical phe-nomena, such as nonlocality. During this internship, we will use the GPT framework to devel-op a model for maximally violating the causal inequality in a way that is analogous to the vio-lation of the Bell-CHSH inequality by the Popescu-Rohrlich boxes.

Keywords

Quantum information

Skills

Softwares