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Correlations in quantum information protocols

ALEJANDRA MARCELA MALDONADO TRAPP
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Advisor: Dr. Luis Roa
Departamento de Física
Facultad de Ciencias Físicas y Matemáticas
Universidad de Concepción
Concepción, Chile.

Co-Advisor: Dr. Charles Clark
Joint Quantum Institute
National Institute of Standards and Technology
University of Maryland
College Park, USA.

Abstract

In this thesis I present four works developed in collaboration during my PhD. The main topic in them was the study of correlations in quantum information protocols with particular emphasis in quantum discord and entanglement.

- In the article entitled *Quantum Discord Underlies the Optimal Scheme for Modifying the Overlap between Two States* J. Phys. Soc. Jpn. **83**, 044006 (2014), we focused on quantum discord in the context of overlap modification between two non-orthogonal states. We showed that only discord is necessary to assist the probabilistic and deterministic protocols for overlap modification.

- In the article entitled *A measure for maximum similarity between outcome states* EPL, **109**, 40001 (2015), we developed a new correlation, similarity degree (SD). Like discord, this quantity characterizes the effect of a local measurement on the other subsystem. We find and analytical expression to calculate it. Addionally, it can be directly measured in an optical setup.

- In the article entitled *Analytical solutions and criteria for the quantum discord of two-qubit X-states* Quantum Inf. Process. **14**, 1947 (2015), we addressed the problem of optimizing the average conditional entropy for computing quantum discord. We established a criteria for finding the measurement that yields the most possible information with the smallest possible disturbance of the system. This work was led by my and done during my research-stay at the Joint Quantum Institute, in collaboration with with Dr. Anzi Hu, a member of the group of Prof. Charles Clark at JQI, and Prof. Luis Roa from Concepción.

- *Realizing quantum advantage without entanglement in single-photon states* is my most recent work, which gives a deeper interpretation of the role of quantum correlations. The theoretical proposal considers an optical system that consists of a two-qubit X-state source, a mechanism for encoding a random variable, and quantum state tomography. This work was done during my internship at the Joint Quantum Institute under

the supervision of Professor Charles Clark. This work should be submitted by March 2016, with an experimental realization to follow.