

**Dr Fabio Costa**

*Local and Causal Structures in Quantum Theory*

Supervisor: Caslav Brukner

ABSTRACT

Quantum mechanics challenges the view that physical properties exist prior to and independent of their observation. Yet, basic notions such as locality or causality are still grounded on a realistic concept of space-time.

In my thesis work, the notions of local and causal structures were studied from an operational point of view. During the defence, I will present a new theoretical framework that allows describing multipartite quantum experiments without assuming any underlying space-time. Within this framework, causal relations are not pre-defined, but can be deduced from the possibility of signalling. It is possible to prove that not all situations for which quantum mechanics is locally valid are compatible with a global causal structure. However, if the local validity of classical physics is required instead, a global order follows necessarily. The result suggests that causal order might not be a fundamental property of nature, but rather emerge in a quantum-to-classical transition.