

PhD THESIS DEFENSE: Introducing tools to quantify the performance of quantum computing algorithms and their applications

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July 18, 2024
10:00
ICFO Auditorium

In this thesis, I focused on introducing tools to quantify the performance of quantum computing algorithms and their applications. The main focus is on two of the most popular application areas of quantum computing, quantum machine learning and quantum chemistry. To this end, I analyze the properties of quantum machine learning models by following statistical method techniques, which can help us build our understanding of the capabilities of such quantum models. Moreover, I introduce the teacher-student scheme as a computational tool to benchmark the performance of different quantum models and their training capabilities. Until large-scale benchmarking is available, these tools can help us

understand the potential of quantum machine learning and guide the research in the right direction. Next, in recent years substantial effort have been devoted to the development of quantum algorithms for quantum chemistry applications. I introduce tools to assess the utility of various combinations of quantum chemistry algorithms. I perform extensive numerical simulations on computationally affordable systems of intermediate size to explore how quantum methods can accelerate tasks of quantum chemistry. These works set a foundation from which to further explore the requirements to achieve quantum advantage in quantum chemistry. Finally, I discuss how research in quantum computing has tended to fall into one of two camps: near-term intermediate scale quantum (NISQ) and fault-tolerant quantum computing (FTQC). Through a quantum chemistry application, I explore how to use quantum computers in transition between these two eras, namely the early fault-tolerant quantum computing (EFTQC) regime.

Thursday July 18, 10:00 h. ICFO Auditorium and Online (Teams)
Thesis Director: Prof. Dr. Maciej Lewenstein and Dr. Patrick Hümbeli
Hosted by: Prof. Dr. Maciej Lewenstein