Congratulations to New ICFO PhD Graduate

Dr. Aikaterini Gratsea graduated with a thesis entitled i¿½Introducing tools to quantify the performance of quant m computing algorithms and their applicationsi¿½

July 18, 2024

We congratulate Dr. Aikaterini Gratsea who defended her thesis today in ICFO's Auditorium. Dr. Gratsea obtained her MSc in Advanced Physics from the University of Crete. She joined the Quantum Optics Theory research group at ICFO led by ICREA Prof. Dr. Maciej Lewenstein as a PhD student.

Dr. Gratsea's thesis entitled i¿½Introducing tools to quantify the performance of quant m computing algorithms and their applicationsi¿½ was supervised by ICREA Prof. Dr. Ma iej Lewenstein and Dr. Patrick Hüm

ABSTRACT:

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.

Thesis Committee:

Dr. Erik Torrontegui Munoz, Universidad Carlos III de Madrid

Prof. Dr. Antonio Acin, ICFO

Dr. Michal Tomza, University of Warsaw

Thesis Committee