Quantum Information Science Talks

UNIVERSITÄT DES SAARLANDES

Monday
May 5, 2025, 12:00 PM
Building E2 6, Room E.11,
Everyone is welcome!

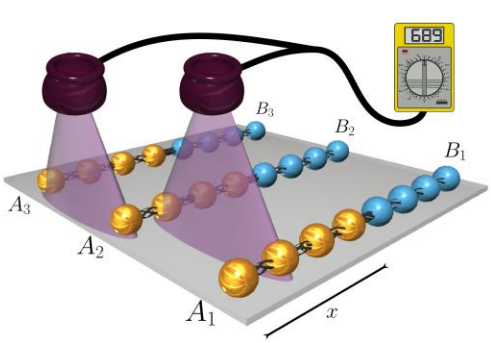
Prof. Dr. Leonardo Banchi

Florence University

Quantifying the Complexity of Learning Quantum Features

Monday, May 5th, 2025 at 12:00 PM
Building E2 6, Room E.11

I will present a combination of different results obtained by our group in the last few years, about quantifying the complexity of learning with quantum data, such as quantum states, quantum dynamics and quantum channels. The ability to extract general laws from a few known examples depends on the complexity of the problem and on the amount of training data. In the quantum setting, the learner's generalization performance is further challenged by the destructive nature of quantum measurements. Example applications include the classification of quantum phases of matter, decision problems, and sensing applications. We will show how to adapt bounds from statistical learning theory to assess which of these tasks are easy for a learner. In some cases, the uncertainty coming from a few measurement shots can be the dominant source of errors. We have identified an instance of this possibly general issue by focusing on the classification of maximally entangled vs. separable states, showing that this toy problem becomes challenging for learners unaware of entanglement theory. On the other hand, we have shown that learning observables whose measurement allows for identification of quantum phases of matter is easy. Finally, we discuss the possibility of achieving quantum advantage in learning classical data, specifically temporal stochastic processes. By studying the trade-off between accuracy and memory requirements, we have shown that quantum models can reach the same accuracy with less memory.



Contact: peter.orth@uni-saarland.de
giovanna.morigi@physik.uni-saarland.de

Website: www.uni-saarland.de/fachrichtung/physik/veranstaltungen/qis-seminar.html