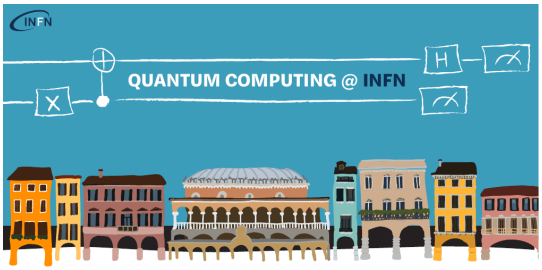

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Two interesting applications of stochastic unravelling in quantum computing

Thursday, 31 October 2024 12:00 (20 minutes)

We present two examples of the application of stochastic calculus in quantum computing.
The first example involves simulating quantum circuits in the presence of noise using classical computers. Instead of directly solving the Lindblad master equation, we utilize its stochastic unravelling to model a random evolution of the state vector. This approach enables us to incorporate noise effects directly into the gates, effectively creating "noisy gates." To study the impact of noise in a circuit, we replace each ideal gate with the corresponding noisy gate, run multiple simulations, and then average the results. We compare this method with the IBM Qiskit simulator, demonstrating that it more accurately reproduces the analytical solution of the Lindblad equation and aligns better with results obtained from real quantum computers.
The second application focuses on simulating open quantum systems using a quantum computer. We begin by constructing a stochastic unravelling of the dynamics we wish to study, employing quantum Itô processes. Then, we introduce a method to simulate this unravelling on a quantum computer. Remarkably, regardless of the number of Lindblad operators that describe the noise, our method requires only a *single* qubit (in addition to those of the system studied) to simulate all environmental effects.

Sessione

Simulazione

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