Quantum Computing, MAGIC and Machine Learning

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Trapped atomic ions are a well-advanced physical system for quantum information science (QIS). QIS is meant to encompass the quest for a universal, or specialized processor for quantum information, the investigation of fundamental questions of quantum physics, as well as applications of techniques emanating from these investigations to other fields, for example, precision spectroscopy and sensing.

In this talk I will focus mainly on quantum computing, and will first introduce essential elements of this research field. In addition, an introduction will be given to the use of trapped ions for state-of-the-art experiments in QIS. Then, the concept of magnetic gradient induced coupling (MAGIC) with trapped ions will be outlined.

Building on this introductory material I will report on the first proof-of-principle experimental demonstration of the deliberation process of a learning agent on a quantum computer. This experiment at the boundary between QIS and machine learning – carried out on a fully programmable miniature quantum computer – shows that decision making for reinforcement learning is sped up quadratically as compared to a classical agent.