UNI FREIBURG
Fakultät für Mathematik und Physik
Albert-Ludwigs-Universität Freiburg
Physikalisches Institut

SONDERKOLLOQUIUM

AM 7. MÄRZ 2016 UM 17 UHR C.T.

IM GROßEN HÖRSAAL

HOW CAN ARTIFICIAL INTELLIGENCE BENEFIT FROM QUANTUM RESOURCES?

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I will describe two architectures, quantum annealers and quantum circuits, that the Quantum AI team at Google is experimenting with in order to learn how to use quantum resources to accelerate tasks important for AI. Quantum annealers are a promising tool to find good solutions to hard combinatorial optimization problems. In recent tests we were able to show that finite range quantum tunneling enables the D-Wave 2X quantum annealer to solve crafted benchmark problems 10^8 times faster than thermal annealing that does not employ tunneling. Another computational resource that only recently attracted attention is many body delocalization, which offers an elegant mechanism for sampling states with low energies, a task useful for probabilistic inference but expensive for classical methods. I will discuss the implications of these studies for the design of next generation quantum annealers. As an example of how to apply quantum annealing to machine learning, I will describe learning from very noisy data. With quantum circuits we implemented what could be described as a quantum neural network. In a first application, we used such a circuit to calculate the energy surface of molecular hydrogen to chemical precision. The resource of interest here are complex quantum states which have a support in Hilbert space so large that they cannot be represented by classical means for even modest size quantum circuits, with just about 50 qubits.