

Rosen Peres *Distinguished Lecture Series* in Quantum Science and Technology



Prof. Christopher Monroe
University of Maryland
& IonQ Inc.

Colloquium:
“Quantum Computing
With Atoms”

March 4th, 2020
14:30 – 15:30 (*refreshments at 14:15*)

Physics Department
Auditorium 323

Seminar:
”Quantum Simulations with
Trapped Ions”

March 5th, 2020
11:00 – 12:00

Solid State Auditorium

HDQC

Colloquium 4.3.2020

TITLE: Quantum Computing with Atoms

ABSTRACT:

Quantum computers exploit the bizarre features of quantum physics - uncertainty, entanglement, and measurement -- to perform tasks that are impossible using conventional means, such as computing over ungodly amounts of data, and communicating via teleportation. I will describe the architecture of a quantum computer based on individual atoms, suspended and isolated with electric fields, and individually addressed with laser beams. This leading physical representation of a quantum computer has allowed unmatched demonstrations of small algorithms and emulations of hard quantum problems with more than 50 quantum bits. While this system can solve some esoteric tasks that cannot be accomplished in conventional devices, it remains a great challenge to build a quantum computer big enough to be useful for society. But the good news is that we don't see any fundamental limits ahead.

Seminar 5.3.2020

TITLE: Quantum Simulations with Trapped Ions

ABSTRACT:

While trapped atomic ions crystals are among the most promising platforms for fully universal quantum computer systems in the future, they are currently being exploited for some of the most advanced quantum simulators of Hamiltonian spin models. Crystals of trapped ions can represent flexible interacting spin systems, with essentially no limits on idle coherence time and nearly perfect projective state measurement. Programmable Ising interactions between spins can be implemented through optical forces that modulate the Coulomb interaction, resulting in a long-range interaction graph with tunable range. We present several examples of quantum simulations of interacting spins represented by chains of trapped ions, including the preparation of ground states and phase transitions, dynamics with strongly-interacting spins including observations of prethermal and MBL phases, and Floquet "time crystals." Some of these experiments are pushing the limits of what can be efficiently simulated on classical computers, and may in the future inform exotic behavior of real materials.