CSU PHYSICS COLLOQUIUM

A Synthetic Quantum Magnet Made of Hundreds of Trapped Ions

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Colorado State University
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Refreshments at 3:45 PM
Location: 120 Engineering (Hammond Auditorium)

Abstract

Entanglement between individual quantum objects exponentially increases the complexity of quantum many-body systems, so systems with more than 30-40 quantum bits cannot be fully studied using conventional techniques and computers. To make progress at this frontier of physics, Feynman’s pioneering ideas of quantum computation and quantum simulation are now being pursued in a wide variety of well-controlled quantum platforms. Trapped-ions are naturally suited for simulating quantum magnetism, and exhibit desirable properties such as high-fidelity state preparation and readout, and long trapping and coherence times. I will discuss how variable range, quantum magnetic interactions can be engineered with trapped ions, focusing on our work with 2-dimensional arrays of several hundred ions crystallized in a Penning ion trap. In particular, I will highlight our recent experiments that benchmark quantum dynamics and entanglement, and utilize our ability to time-reverse the dynamics to measure out-of-time-order correlation functions that quantify the spread of quantum information throughout the system.

Biographical Sketch

John Bollinger is a staff scientist in the Time and Frequency Division of the National Institute of Standards and Technology (NIST). Bollinger received undergraduate degrees in physics and mathematics from Cornell University in 1974, and a Ph.D. in physics from Harvard University in 1981. His research interests include precision measurements, studies on the collective and cold plasma behaviour of laser-cooled ion crystals in Penning traps, and the use of trapped ion crystals for quantum information studies, including quantum simulation and quantum metrology. See https://www.nist.gov/pml/time-and-frequency-division/ion-storage/penning-traps for recent publications.