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Quantum Entanglement in 2D Arrays of Trapped Ions

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120 Engineering (Hammond Auditorium)

Abstract

Entanglement between individual quantum objects exponentially increases the complexity of quantum many-body systems, such that systems with more than 50 quantum bits cannot be fully studied using conventional techniques on classical 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 platforms. Trapped-ion quantum systems are naturally suited for simulating quantum magnetism, with high-fidelity state preparation and readout, long trapping and coherence times, and strong, tunable spin-spin interactions. I will discuss how we engineer quantum magnetic interactions in 2-dimensional arrays of hundreds of Be+ ions, crystallized in a Penning trap. I will explain how we can generate and observe entanglement using these interactions, and I describe a technique we use to observe the spread of quantum coherence through the system by measuring out-of-time-order correlation functions.

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Biography:

Dr. Justin Bohnet is a Senior Research Scientist at Honeywell Quantum Solutions in Broomfield, CO, involved in research and development of a trapped-ion quantum computer. Previously, he was a National Research Council Postdoctoral Fellow at the National Institute of Standards and Technology (NIST) in Boulder, Colorado. Justin received his Ph.D. from the University of Colorado in Boulder and his Bachelor's degree from the University of Northern Iowa in Cedar Falls, Iowa. His work has been featured in Nature, Science, Physical Review Letters, and Physics Today.