CSU PHYSICS COLLOQUIUM

"Quantum Information Science with Laser-dressed Atoms: From Qubit to Qudecimal"

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Monday, October 30th at 4:00 PM

Abstract

Neutral atoms coupled to highly-excited Rydberg levels are an emerging platform for quantum science, with promising applications in quantum computing, quantum simulation, and quantum sensing. In this presentation, I will highlight some of recent experimental and theoretical work, including work towards demonstrating a Mølmer–Sørensen-like gate between two neutral atoms. I will further discuss our work at LANL towards entangling 10-level nuclear spins, or qudecimals, in 87Sr atoms. Here, full control and entanglement would allow more resources per atom, as well as flexible encoding schemes. This research is supported by the Laboratory Directed Research and Development program of Los Alamos National Laboratory under project numbers 20200015ER, 20210116DR, 20210064DR, and 20240295ER . This research is also supported by the U.S. Department of Energy, Office of Science, National Quantum Information Science Research Centers.

Biography

Michael J. Martin graduated from Harvey Mudd College in 2006 with a B.S. in physics, and from University of Colorado in 2013 with a PhD in physics. His PhD research was in the group of Jun Ye, where he developed optical atomic frequency standards. His research in ultrastable lasers and quantum many-body aspects of optical lattice systems enabled quantum-limited performance in an strontium-87 optical lattice clock. He then joined Caltech as an Institute for Quantum Information and Matter (IQIM) postdoctoral scholar, where he and coworkers in the group of H. Jeff Kimble demonstrated strong atomic interactions with photons in engineered, nanophotonic waveguides—a possible building block for quantum networks and chip-scale quantum technologies. He then joined Sandia National Laboratories as a Harry S. Truman Fellow, where he led research in neutral atom quantum information science. He joined Los Alamos National Laboratory (LANL) in 2018 to develop a research program in neutral atom quantum information science, and currently leads several experimental efforts related to quantum sensing, quantum simulation, and quantum computing with individually-trapped Sr and Rb atoms excited to Rydberg states. He presently serves as the Deputy Group Leader for the Materials Physics and Applications Quantum group (MPA-Q) at LANL.