UCLA Department of Physics & Astronomy

COLLOQUIUM

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Building a quantum world with trapped ions

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Trapped ions give us a high degree of detailed control of their various quantum degrees of freedom, which has enabled a large number of experiments in quantum optics, quantum computing, simulation and networking as well as precision metrology and others. We describe our quantum architecture consisting of a linear chain of trapped 171 Yb+ ions with individual laser beam addressing and readout. The collective modes of motion in the chain are used to efficiently produce entanglement between any qubit pair. In combination with a classical software stack, this becomes in effect an arbitrarily programmable, fully connected quantum computer. Over the past five years, we have employed this experiment to demonstrate a variety of quantum algorithms with the help of a community of academic partners, including cross-hardware comparisons with commercially developed systems and digital quantum simulations of models from high-energy physics and other areas. We also use the same level of control to study interesting quantum phenomena using the motional degrees directly, such as exotic para particles. This talk will give recent highlights from both of these approaches and discuss improvements in trap technology for scaling up as well as other ideas for the future.

Undergraduates Welcome!