Contribution ID: **19** Type: **not specified**

Pear-Shaped Qubits: Quantum Computing with Dipolar Molecules

Monday, January 28, 2019 3:00 PM (25 minutes)

Electrically neutral dipolar molecules prepared in the absolute ground state represent one of the newest additions to the quantum-information and simulation family tree. Prepared in the lowest rotational state ($N = 0$), and in the absence of a polarizing electric field, neutral dipolar molecules lack a lab-frame electric dipole moment (EDM). However, admixing components of higher rotational states generates an EDM of order a Debye (for the bialkalis) which provides a route to controllable long-range interactions. It is the tunability of this interaction that makes these molecules an ideal candidate for qubits. Furthermore, using the same scheme one can add a long-range interaction term to the optical-lattice Hubbard Hamiltonian creating the opportunity to study dipolar exchange physics. One can also choose to polarize the molecules with a strong electric field in order to, for example, investigate quantum magnetism in the XXZ-Hamiltonian.

Bialkali molecules represent an excellent opportunity to apply state of the art techniques from the world of degenerate gasses to advance the field of quantum computation. I will discuss our current effort towards creating ground state bosonic Lithium-Rubidium molecules and present some technical challenges we think could benefit from collaboration with the LBL community.

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Session Classification: Architecture II

Track Classification: Qubit architectures