1154-68-1338 **Nathan Wiebe*** (nathan.wiebe@pnnl.gov). *Generative training of quantum Boltzmann machines with hidden units.* Preliminary report.

In this talk we provide a method for fully quantum generative training of quantum Boltzmann machines with both visible and hidden units while using quantum relative entropy as an objective. This is significant because prior methods were not able to do so due to mathematical challenges posed by the gradient evaluation. We present two novel methods for solving this problem. The first proposal addresses it, for a class of restricted quantum Boltzmann machines with mutually commuting Hamiltonians on the hidden units, by using a variational upper bound on the quantum relative entropy. The second one uses high-order divided difference methods and linear-combinations of unitaries to approximate the exact gradient of the relative entropy for a generic quantum Boltzmann machine. Both methods are efficient under the assumption that Gibbs state preparation is efficient and that the Hamiltonian are given by a sparse row-computable matrix. (Received September 16, 2019)