Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Demonstration of quantum superiority in learning parity with noise with superconducting qubits[1] DIEGO RISTÈ, MARCUS DA SILVA, COLM RYAN, Raytheon BBN Technologies, ANDREW CROSS, JOHN SMOLIN, JAY GAMBETTA, JERRY CHOW, IBM T.J. Watson Research Center, BLAKE JOHNSON, Raytheon BBN Technologies — A problem in machine learning is to identify the function programmed in an unknown device, or oracle, having only access to its output. In particular, a parity function computes the parity of a subset of a bit register. We implement an oracle executing parity functions in a five-qubit superconducting processor and compare the performance of a classical and a quantum learner. The classical learner reads the output of multiple oracle calls and uses the results to infer the hidden function. In addition to querying the oracle, the quantum learner can apply coherent rotations on the output register before the readout. We show that, given a target success probability, the quantum approach outperforms the classical one in the number of queries needed. Moreover, this gap increases with readout noise and with the size of the qubit register. This result shows that quantum advantage can already emerge in current systems with a few, noisy qubits.

[1]We acknowledge support from IARPA under contract W911NF-10-1-0324.

Diego Ristè
Raytheon BBN Technologies

Date submitted: 25 Nov 2015 Electronic form version 1.4