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Boson Sampling with Trapped Ions KATHERINE COLLINS, Univ of Maryland-College Park, KENNETH WRIGHT, CHRISTOPHER RICKERD, CHRISTOPHER MONROE, Univ of Maryland-College Park and Joint Quantum Institute — A classical computer is limited in its ability to solve certain types of problems. A quantum computer might be able to solve some of these problems more efficiently. Calculating the permanent of an NxN matrix is an example of a problem that cannot be efficiently solved by a classical computer. Computing the permanent of an NxN matrix can be related to the probability of finding a given occupation distribution for M bosonic modes populated with N identical bosons. This type of experiment is known as boson sampling. Classically, the computation time required to evaluate the permanent of an NxN matrix scales on the order of $2^N N^2$.[1] A quantum device that is able to compute an NxN permanent through boson sampling represents a physical device that can evaluate a problem not efficiently solvable by a classical system. Some experiments have already demonstrated boson sampling with photons for a small number of bosonic modes, but it is difficult to increase the number of bosons in such experiments. One way to demonstrate a larger-scale boson sampling problem is to use the phonon excitations of a trapped ion chain. We present our progress towards experimentally demonstrating boson sampling with trapped ions.

[1]C. Shen, Z. Zhang, and L.-M. Duan, Phys. Rev. Lett. 112, 050504, 2014

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