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Implementation of Quantum Plug and Play Protocol in a Trapped Ion System[1] KUAN ZHANG, XIANG ZHANG, YANGCHAO SHEN, YAO LU, SHUAINING ZHANG, JIAJUN MA, KIHWAN KIM, Center for Quantum Information, IIIS, Tsinghua University, Beijing, P. R. China, MILE GU, Centre for Quantum Technologies, Nanyang Technology University, Singapore, JAYNE THOMPSON, VLATKO VEDRAL, Centre for Quantum Technologies, National University of Singapore, Singapore — For the large-scale computer programing, it is important to modularize the program into many small parts, which are called as module. To integrate the modules in the program, all that we need to know is the relation between inputs and outputs not the specific details of the physical implementation. However, such modularity is generically impossible to be adapted in quantum computing [1]. It was discussed with the example of deterministic quantum computing with one qubit (DQC1), which efficiently computes the trace of a unitary matrix U. The authors in Ref. [1] pointed that if we compute $|Tr(U)|$ instead of $Tr(U)$, the whole process can be modularized. We implement the proposed quantum plug and play protocol in the simplest situation in our trapped ion system. In the protocol, we begin with 1 pure control qubit and 2 completely mixed registers, which are swapped on a state of the control qubit. The $|Tr(U)|$ is computed for any arbitrary unitary operation performed on the one of the register. [1] Jayne Thompson, et al., arXiv:1310.2927v5 (2013).

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Kuan Zhang
Center for Quantum Information, IIIS, Tsinghua University, Beijing, P. R. China

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