Quantum compilation optimized for experiments with multi-qubit gates\footnote{This work is supported by the National Natural Science Foundation of China (Grant No. 11704408), the National Postdoctoral Program for Innovative Talents (Grant No. BX201601908) and the China Postdoctoral Science Foundation (Grant No. 2017M620991).} LIANGYU DING, XIANG ZHANG, QIUXIN ZHANG, DANNA SHEN, XIRAN SUN, WEI ZHANG, Renmin Univ of China — There is increasing interest in implementing quantum algorithms via simpler and shorter experimental operations for building universal quantum computers. Here, we present a general quantum computation compiler, which maps arbitrary quantum algorithm to an optimal quantum circuit consisting of a sequential set of universal gates which is feasible to operate directly in experiment with atomic qubits by lasers. We implement several methods, including matrix elementary decomposition, cosine-sine decomposition, quantum Shannon decomposition and Cartan's KAK decomposition, to transform the quantum algorithm into a series of one-bit gates and specific two-bit or multi-bit gates. The compiler optimizes experimental gate sequence by heuristically applying mirroring and merging tricks. Moreover, we use algebraic decomposition and numerical optimization method to compile unitaries using native multi-bit gates, i.e., Ising gates, which significantly reduce gate numbers. The compilation technique is practically favorable and will be used in our following trapped ions experiment.