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Accurate quantum Z rotations with less magic ANDREW LANDAHL, Sandia National Laboratories, CHRIS CESARE, University of New Mexico — We present quantum protocols for executing arbitrarily accurate $\pi/2^k$ rotations of a qubit about its Z axis. Unlike reduced instruction set computing (RISC) protocols which use a two-step process of synthesizing high-fidelity "magic" states from which $T = Z(\pi/4)$ gates can be teleported and then compiling a sequence of adaptive stabilizer operations and T gates to approximate $Z(\pi/2^k)$, our complex instruction set computing (CISC) protocol distills magic states for the $Z(\pi/2^k)$ gates directly. Replacing this two-step process with a single step results in substantial reductions in the number of gates needed. The key to our construction is a family of shortened quantum Reed-Muller codes of length $2^{k+2} - 1$, whose distillation threshold shrinks with k but is greater than 0.85% for $k \leq 6$. AJL and CC were supported in part by the Laboratory Directed Research and Development program at Sandia National Laboratories. Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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