

Abstract Submitted  
for the MAR17 Meeting of  
The American Physical Society

**The randomized benchmarking number is not what you think it is** TIMOTHY PROCTOR, KENNETH RUDINGER, ROBIN BLUME-KOHOUT, MOHAN SAROVAR, KEVIN YOUNG, Sandia National Laboratories — Randomized benchmarking (RB) is a widely used technique for characterizing a gate set, whereby random sequences of gates are used to probe the average behavior of the gate set. The gates are chosen to ideally compose to the identity, and the rate of decay in the survival probability of an initial state with increasing length sequences is extracted from a set of experiments – this is the ‘RB number’. For reasonably well-behaved noise and particular gate sets, it has been claimed that the RB number is a reliable estimate of the average gate fidelity (AGF) of each noisy gate to the ideal target unitary, averaged over all gates in the set. Contrary to this widely held view, we show that this is not the case. We show that there are physically relevant situations, in which RB was thought to be provably reliable, where the RB number is many orders of magnitude away from the AGF. These results have important implications for interpreting the RB protocol, and immediate consequences for many advanced RB techniques. Sandia National Laboratories is a multi-mission 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.

Timothy Proctor  
Sandia National Laboratories

Date submitted: 07 Nov 2016

Electronic form version 1.4