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Variability metrics in Josephson Junction fabrication for Quantum Computing circuits SAMI ROSENBLATT, JARED HERTZBERG, MARKUS BRINK, JERRY CHOW, JAY GAMBETTA, IBM T. J. Watson Research Center, ZHAOQI LENG, ANDREW HOUCK, Princeton University, J.J. NELSON, BRITTON PLOURDE, Syracuse University, XIAN WU, RUSSELL LAKE, JEFF SHAINLINE, DAVID PAPPAS, National Institute of Standards and Technology, Boulder, CO, UMESHKUMAR PATEL, ROBERT MCDERMOTT, University of Wisconsin, Madison — Multi-qubit gates depend on the relative frequencies of the qubits. To reliably build multi-qubit devices therefore requires careful fabrication of Josephson junctions in order to precisely set their critical currents. The Ambegaokar-Baratoff relation between tunnel conductance and critical current implies a correlation between qubit frequency spread and tunnel junction resistance spread. Here we discuss measurement of large numbers of tunnel junctions to assess these resistance spreads, which can exceed 5% of mean resistance. With the goal of minimizing these spreads, we investigate process parameters such as lithographic junction area, evaporation and masking scheme, oxidation conditions, and substrate choice, as well as test environment, design and setup. In addition, trends of junction resistance with temperature are compared with theoretical models for further insights into process and test variability.

Sami Rosenblatt
IBM T. J. Watson Research Center

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