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Designing entangling microwave gates between fixed frequency superconducting circuits coupled by resonators[1] SETH MERKEL, JAY GAMBETTA, JOHN SMOLIN, IBM, IBM QUANTUM COMPUTING TEAM TEAM — Many of the recent techniques for controlling superconducting quantum circuits are directly derived from the atomic theory of cavity QED, and the fixed frequency transmon provides a particularly close analogy to an "artificial atom." However, even in this case new modelling techniques are required as we engineer parameter regimes that have been previously unexplored in atomic systems. In this talk we develop the Schrieffer-Wolff transformation as a means of adiabatically eliminating high-energy subspaces in order to derive effective entangling Hamiltonians. We can use this theory to explain many of the recent, experimentally demonstrated fixed frequency gates such as the cross-resonance gate and the two-photon 00 to 11 transition. In the case of the cross-resonance gate this more detailed model predicts spurious single qubit rotations, and their rates, which can then be removed through refocusing techniques.

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