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**Spurious modes in 3D multi-qubit circuits**[1] MARTIN SANDBERG, DOUGLAS MCCLURE, HANHEE PAIK, IBM T.J. Watson Research Center, Yorktown Heights, New York, 10598, USA, DANIELA F. BOGORIN, B.L.T. PLOURDE, Syracuse University, Physics Department, Syracuse, NY 13244 USA, OLIVER DIAL, BALEEGH ABDO, IBM T.J. Watson Research Center, Yorktown Heights, New York, 10598, USA — In superconducting 3D circuits coherence times exceeding 100 microseconds are readily achieved for qubits in single cavities. One approach to building more complex circuitry in the 3D architecture is to use "bridge" qubits that span into two adjacent cavities. It has been found that these qubits exhibit reduced coherence compared to single cavity qubits. Significant effort has been put into understanding and improving the coherence of the bridge qubit. So far the mechanisms behind the reduced coherence have remained somewhat unclear. Here we present simulations and measurements indicating that stray modes in the microwave environment are one contributing factor to the reduced coherence. One potential location of such stray modes is at the boundary regions between sections of the cavity enclosure, where both machining imperfections and dielectric layers such as oxides can prevent perfect electrical contact. As these systems are scaled up, the spectrum of the modes becomes increasingly dense, presenting an increasing challenge. We present multiple methods that can be implemented to mitigate these modes.

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