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Development of superconducting bonding for multilayer microwave integrated quantum circuits TERESA BRECHT, CHRISTOPHER AXLINE, YIWEN CHU, WOLFGANG PFAFF, LUIGI FRUNZIO, MICHEL DEVORET, ROBERT SCHOELKOPF, Yale University — Future quantum computers are likely to take the shape of multilayer microwave integrated quantum circuits.[1] The proposed physical architecture retains the superb coherence of 3D structures while achieving superior scalability and compatibility with planar circuitry and integrated readout electronics. This hardware platform utilizes known techniques of bulk etching in silicon wafers and requires metallic bonding of superconducting materials. Superconducting wafer bonding is a crucial tool in need of development. Whether micromachined in wafers or traditionally machined in bulk metal, 3D cavities typically posses a seam where two parts meet. Ideally, this seam consists of a perfect superconducting bond. Pursuing this goal, we have developed a new understanding of seams as a loss mechanism that is applicable to 3D cavities in general.[2] We present quality factor measurements of both 3D cavities and 2D stripline resonators to study the losses of superconducting bonds. [1]Brecht, T. *et al.*, arXiv:1509.01127 (2015) [2]Brecht, T. *et al.*, arXiv:1509.01119 (2015)

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