On-chip engineered heat baths for quantum devices

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Engineering and control of dissipation is important for practical applications of quantum devices and for observing new environment-related quantum phenomena. To this end, I present experiments where engineered on-chip heat baths are utilized. Namely, we observe quantum-limited heat conduction across distances of the order of a meter and demonstrate two concepts for on-demand dissipation: a quantum-circuit refrigerator and a tunable heat sink. The refrigerator can be turned on and off using a single bias voltage whereas the heat sink is controlled with magnetic flux. We show that these devices can be used to change the quality factors or superconducting resonators by orders of magnitude in nanosecond time scales. Furthermore, we present the first observations of the Lamb shift owing to a broadband environment in superconducting circuits.