# A frequency and sensitivity tunable mircoresonator array for high-speed quantum processor readout

**Main author:**

WHITTAKER Jed

**Co-authors:**

Altomare Fabio, D-Wave Systems, Inc.
Berkley Andrew, D-Wave Systems, Inc.
Bumble Bruce, Jet Propulson Laboratories
Bunyk Paul, D-Wave Systems, Inc.
Day Peter, Jet Propulson Laboratories
Eom Byeong, Jet Propulson Laboratories
Harris Richard, D-Wave Systems, Inc.
Hilton Jeremy, D-Wave Systems, Inc.
Hoskinson Emile, D-Wave Systems, Inc.
Johnson Mark, D-Wave Systems, Inc.
Kleinsasser Alan, Jet Propulson Laboratories
Ladizinsky Eric, D-Wave Systems, Inc.
Lanting Trevor, D-Wave Systems, Inc.
Oh Travis, D-Wave Systems, Inc.
Perminov Ilya, D-Wave Systems, Inc.
Spear Peter, D-Wave Systems, Inc.
Swenson Loren, D-Wave Systems, Inc.
Tolkacheva Elena, D-Wave Systems, Inc.
Volkmann Mark, D-Wave Systems, Inc.
Whittaker Jed, D-Wave Systems, Inc.
Wilkinson Warren, D-Wave Systems, Inc.
Yao Jason, D-Wave Systems, Inc.

Superconducting microresonators have been successfully utilized as detection elements for a wide variety of applications. With multiplexing factors exceeding 1,000 detectors per transmission line, they are the most scalable low-temperature detector technology

demonstrated to date. For high-throughput applications, fewer detectors can be coupled to a single wire but utilize a larger per-detector bandwidth. For all existing designs, fluctuations in fabrication tolerances result in a non-uniform shift in resonance frequency and sensitivity, which ultimately limits the efficiency of bandwidth utilization. Here we present the design, implementation, and initial characterization of a superconducting microresonator readout integrating two tunable inductances per detector. We demonstrate that these tuning elements provide independent control of both the detector frequency and sensitivity, allowing us to maximize the transmission line bandwidth utilization. Finally we discuss the integration of these detectors in a multi-layer fab stack for high-speed readout of the D-Wave quantum processor, highlighting the use of a lattice of single-flux quantum storage loops to minimize the number of control wires at the lowest temperature stage.