The two logical states of a persistent current (PC) qubit correspond to oppositely circulating currents in the qubit loop. The induced magnetic flux associated with the current either adds to or subtracts from the background flux. The state of the qubit can thus be detected by a DC superconducting quantum interference device (SQUID) magnetometer inductively coupled to the qubit. We have implemented a resonant technique that uses a SQUID as a flux-sensitive Josephson inductor for qubit readout. This approach keeps the readout SQUID biased at low currents along the supercurrent branch. Because the low bias reduces the level of decoherence on the qubit, it is more desirable for quantum computing applications. We also incorporated the SQUID inductor in a high-Q on-chip resonant circuit. This enabled us to distinguish the two flux states of a niobium PC qubit by observing a shift in the resonant frequency of the readout circuit. The nonlinear nature of the SQUID Josephson inductance, as well as its effect on the resonant spectra of the readout circuit, was also characterized.

References:
