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High – impedance superconducting resonator for the dispersive readout of a nanomechanical qubit

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Since DiVincenzo's criteria for quantum computation were proposed [1], people have imagined qubits (i.e., the minimal unit of quantum information) created by many different physical systems. To have a qubit you need access to two quantized states, and the possibility to control and do a readout of them in a coherent fashion.

The recent developments in quantum devices pursue not only the possibility to do quantum computing [2], but also to make advances in communication and sensing technologies, as well as simulation of other quantum mechanical systems. Mechanical resonators are good candidates for these tasks due to their high-quality factors and ease to couple to different interactions.

Mechanical states are very resilient to environmental noise and a mechanical qubit is expected to have longer coherence times than other condensed matter-based analogues. To achieve in the creation of a mechanical qubit with a Carbon Nanotube [3], I will describe how to create and manipulate a qubit inside a CNT and do the readout of the qubit state through the electric-dipole coupling to a superconducting resonator [4].

Lastly, I show a particular design for an optically lithographed high – impedance spiral resonator made of Niobium and explain how one can simulate and characterize the resonators to extract the relevant parameters.

References

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