Invited talks

Superconducting resonators for space and quantum applications

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Superconducting microwave resonators are crucial elements in many quantum science and technology applications such as quantum electrodynamics circuitry, quantum sensing and astronomy detectors. Particularly, we are focused on the development of Lumped Element superconducting Resonators (LERs). LERs are high-quality factor resonators based on a series inductance-capacitance superconducting circuit coupled in parallel to a single transmission line.

Kinetic Inductance Detectors (KIDs) are state-of-the-art radiation detectors based on the change of the kinetic inductance of LERs when a photon interacts with them. We are employing these devices in millimeter and submillimeter astronomical experiments such as the study of the Cosmic Microwave Background (CMB) radiation which require a great number of extra-high sensitivity detectors arranged in large format cameras. The main advantage of KIDs over other types of detectors is that LER architecture allows to lay out thousands of resonators all of them easily integrated within a single transmission line. This passive frequency-domain multiplexing is especially useful providing the wide field of view necessary to map the CMB.

Resonators based on LERs are also a fundamental component for quantum computers circuitry. Their flexibility in design and compact nature implies a great advantage over distributed resonators regarding scalability, speed, and fidelity. Their recent introduction to spin-based quantum computation promises to enhance this research field. In particular, the highly intense magnetic field produced by LERs allows initializing qubits codified within small spin ensembles, which offer coherence times far larger than the superconducting qubits used in other quantum platforms. In the future, these developments will produce highly compact units even able to perform their own error correction protocols. Furthermore, the capability of multiplexing different LERs along a single transmission line allows interaction with different spin-based qubits at the same time.

In this talk, I will present our efforts on developing and optimizing LERs for its use as Kinetic Inductance Detectors for astronomical experiments and as building blocks for Molecular Spin on-chip Quantum Processors.