

A Generalized Equivalent Circuit Applied to a Tunable Sapphire-Loaded Superconducting Cavity

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A Lagrangian technique is used to develop an equivalent circuit for a loop-coupled tunable sapphire-loaded superconducting cavity resonator (T-SLOSC) by considering separately the sapphire dielectric and the cavity. Interaction between modes during tuning is characterized by cross coupling components between equivalent mode circuits. Cross-coupling coefficients are defined with respect to the fields in the resonator and equivalent circuit components. Coupling between modal fields is shown to be predominantly reactive in the sapphire-loaded cavity, and can degrade a mode with $Q > 10^8$ by a few orders of magnitude. Interactions between line resonances and T-SLOSC modes are observed to be predominantly resistive through the superconducting niobium probes. Cross-coupling coefficients between some interacting modes have been determined and the reflection coefficients modeled.

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