HQOC

HARVARD Quantum Optics Center

INSTITUTE FOR THEORETICAL ATOMIC, MOLECULAR AND OPTICAL PHYSICS

at the Harvard-Smithsonian Center for Astrophysics and Harvard Physics Department, Cambridge MA USA

Special Seminar

Friday | Jan. 18 | 11:00 AM
Lyman 425

Lara Faoro

Visiting Scholar, Condensed Matter Theory,
Rutgers, The State University of New Jersey

"Internal Loss of Superconducting Resonators Induced by Interacting Two Level Systems (TLS)"

High quality superconducting resonators are used in a number of diverse fields, ranging from astronomical photon detection to circuit quantum electrodynamics. In these applications, the resonator is operated in a regime of low temperature (~10 mk) and low excitation power (single photon). The performance of these devices is directly related to the resonator quality factor, *Q*, defined by the photon decay rate, γ_{ph}, as Q = ω_0 / γ_{ph} ,where ω_0 is the resonance frequency. γ_{ph} is given by the sum of the escape rate from the resonator and the rate of the intrinsic decay; the latter sets the limit on the performance. At low temperature and single photon regime, the intrinsic decay is usually attributed to the excitations of TLS located in the dielectrics (bulk and surfaces) surrounding the resonator. This belief is strongly supported by the observation of temperature-dependent resonance frequency shift that closely agrees with the one predicted by the conventional theory of microwave absorption of TLS in glasses. According to this theory, one expects also that, as the power of the radiation applied to resonator is increased, TLS in the dielectrics get saturated, thereby limiting the maximal power that can be dissipated by photons. This results in a strong power dependence of the quality factor. However, in a number of recent experiments with microwave high quality superconducting resonators an anomalously weak power dependence of the quality factor has been observed. We argue that this observation implies that the monochromatic radiation does not saturate the Two Level Systems located at the interface oxide surfaces of the resonator and suggests the importance of their interactions. We estimate the microwave loss due to interacting TLS and show that the interactions between TLS lead to a drift of their energies that result in a much slower, logarithmic dependence of their absorption on the radiation power in agreement with the data.