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1/f permittivity noise probed uniformly in a film with two level systems: The power law of field saturation and the relationship to loss
KEVIN OSBORN, Laboratory for Physical Sciences and Joint Quantum Institute, ARUNA RAMANAYAKA, BAHMAN SARABI, Laboratory for Physical Sciences and University of Maryland Physics Dept., U. OF MARYLAND TEAM — Noise from atomic tunneling two-level systems (TSs) limit the performance of various superconducting devices, ranging in application from astronomy to quantum computing. We study superconducting resonators with films containing TS and measure the resulting 1/f frequency noise caused by resonant TS. The resonators are designed such that they apply a uniform ac electric field to the films which allows a direct measurement of permittivity noise in the film as a function the electric field. An intrinsic value of noise is found as well as the power law for ac-field saturation. The temperature dependence of 1/f noise below 200 mK fits to a relationship found previously in high-Q resonators. However, our data lead us to a model different than a previous experimental study; in our work TS phenomena are modeled with frequency diffusion. Our measured noise times the temperature is found to be the same to within error in the different films when normalized to the loss tangent at low temperature, despite dramatically different loss tangents. Following from the general nature of the TS models, we expect the same permittivity noise in many other devices.

Kevin Osborn
Laboratory for Physical Sci

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