

rf SQUID Metamaterials: A Rich Nonlinear Setting for Applications

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Abstract— We summarize work on the nonlinear properties of radio frequency Superconducting Quantum Interference Device (rf SQUID) based metamaterials and discuss how this platform enables new applications. The metamaterials show extreme tunability of their resonant response, ranging in principle from 10's of GHz to zero frequency, all within the tuning parameter range of one-half flux quantum of magnetic field. They also display strong and tunable intermodulation response and can be used for amplification and mixing. We also investigate the “dark modes” of oscillation of the rf SQUID metamaterial through a microscopic investigation of the status of each SQUID in the array while in operation under cryogenic conditions. These images reveal very complex behavior of the metamaterial in the low excitation strength limit. Surprisingly, we find that large rf flux amplitudes change the metamaterial response and tend to erase defects and disorder to create coherent oscillations of the array.

Keywords (Index Terms) — rf SQUID, metamaterial, intermodulation, laser scanning microscope, chimera.

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