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Extremely nonlinear and switchable SQUID metamaterial[1]
DAIMENG ZHANG, MELISSA TREPANIER, Univ of Maryland-College Park, OLEG MUKHANOV, Hypres, Inc, PHILIPP JUNG, SUSANNE BUTZ, ALEXEY USTINOV, Karlsruhe Institute of Technology, STEVEN ANLAGE, Univ of Maryland-College Park — We present experimental results on a superconducting metamaterial with remarkably nonlinear and switchable properties in the microwave range. The meta-atoms are RF Superconducting Quantum Interference Devices (SQUIDs), a superconducting loop interrupted by a single Josephson Junction. RF SQUIDs are similar to split-ring resonators except that the inductance is tunable due to the nonlinear Josephson inductance. This metamaterial has high tunability via DC magnetic field, temperature and applied RF power [1]. Here we focus on the nonlinearity in our metamaterial due to the Josephson effect. The intermodulation measurements show a highly nonlinear response from the metamaterial. In an RF power dependence experiment we observed hysteretic behavior in transmission which indicates the metamaterial is a nonlinear multi-state system. As a result, we can control the transmission by switching between metastable states via manipulating the applied RF power. We also observe a unique self-induced transparency of meta-atoms in a certain applied RF power range. This extremely nonlinear metamaterial has potential application for next-generation digital RF receiver systems.

[1] M. Trepanier*, D. Zhang*, O. Mukhanov, S.M. Anlage, Phys. Rev. X (in press), arXiv:1308.1410v2.

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Daimeng Zhang
Univ of Maryland-College Park

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