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Single Superconducting Split-Ring Resonator Electrodynamics MICHAEL C. RICCI, STEVEN M. ANLAGE, University of Maryland, College Park — In order to create compact metamaterial devices in the microwave frequency range, current designs must be scaled down to smaller dimensions. However, at such scales, normal metal losses dominate, and desirable device properties (*e.g.* negative index of refraction) are lost. We investigate the properties of superconducting Nb metamaterials that do not suffer from these limitations. The experiments are performed in an all-Nb waveguide, with Nb wires and Nb thin film split-ring resonators (SRRs). Transmission experiments performed in vacuum show a narrow, deep notch for a single Nb SRR (quality factor $\sim 50,000$), and no notch for a Cu resonator of similar dimensions. Adding SRRs increases the notch bandwidth, but decreases the insertion loss of individual resonators. In addition, placing a single superconducting SRR into an array of superconducting wires produces a single negative-index pass-band 40 dB above the noise floor, with a quality factor of $\sim 22,000$. Models based on the permeability of individual SRRs and the effective dielectric response of a wire array are used to fit the data. This work is supported by the NSF through Grant No. NSF/ECS-0322844, and the DI Outreach Program.

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