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Electromagnetic Response of Josephson Junction Metamaterials in Positive and Negative Permittivity Regimes[1] STEVEN ANLAGE, LAURA ADAMS, Center for Nanophysics and Advanced Materials, Physics Department, University of Maryland, College Park, MD 20742-4111 — Negative index of refraction metamaterials have shown strikingly different behavior than their positive index of refraction counterparts, enabling for example cloaking and super lensing. Josephson junction (JJ) metamaterials which are tunable and have low loss are a distinct advantage not only because of their nonlinearity but also due to their ability to be scaled down in size. We will present microwave measurements of JJ arrays that behave differently depending on whether the arrays resonate above or below the cutoff frequency of an electromagnetic waveguide. Below cutoff, resonances seem to indicate a macroscopic phase coherence of the JJ arrays with emission of photons. Above cutoff, we interpret the interaction between the arrays and the electromagnetic waves as indications of vortex-anti-vortex physics. We will describe how the JJ arrays respond to controlled changes of the input power, temperature and dc magnetic fields and how these responses depend on the sign of the permittivity.

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