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Negative response and intrinsic localization in rf SQUID metamaterials. GEORGE TSIRONIS, NIKOLAOS LAZARIDES, MARIA ELEFTHERIOU, University of Crete, and Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas — A periodic array of rf SQUIDs in an alternating magnetic field acts as an inherently nonlinear magnetic metamaterial, due to the nonlinearity of the Josephson element and the resonant properties of the SQUIDs themselves. Neighboring SQUIDs are weakly coupled due to magnetic dipole-dipole interaction through their mutual inductances, allowing an effective medium description if the wavelength of the applied field is much larger than the array period. We found that SQUID arrays can provide negative magnetic response, and thus negative permeability, above the resonance frequency of the individual SQUIDs. Moreover, that response can be tuned by the applied flux. Dissipative SQUID arrays, modeled as discrete networks, support nonlinear excitations in the form of intrinsic localized modes (discrete breathers). We found that dissipative discrete breathers exist in both one- and two-dimensional SQUID arrays. Furthermore, those breathers alter locally the magnetic response of an array from paramagnetic to diamagnetic or vice versa.

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