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Quantum Josephson Junction Metamaterials LAURA ADAMS, HUA XU, STEVEN ANLAGE, University of Maryland — Recent breakthroughs in the field of artificial electromagnetic materials, known as metamaterials, have opened the door to creating structures which exhibit extraordinary properties not generally found in nature such as negative index of refraction. By engineering structures that are small compared to the wavelength of operation, material parameters such as (electric) permittivity and (magnetic) permeability can be designed. However there are significant limitations in these structures due their sensitivity to losses which increase with decreasing size. One straightforward way of getting around this issue is to use superconductors which also have the advantage of tunability. Even more sophisticated are arrays of Josephson Junctions (two superconducting islands separated by a thin insulating barrier) which have the distinct advantage of behaving as quantum metamaterials due to their nonlinear microwave inductance tunable by external DC and AC fields. We will discuss the tunability of these arrays as a function of temperature and magnetic field and the possibilities for negative permeability over a wide range of microwave frequencies.

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