MAR17-2016-005086

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Nonlinear electromagnetic response of superconducting quantum metamaterials

SHIRO KAWABATA, National Institute of Advanced Industrial Science and Technology (AIST)

Metamaterials are artificial electromagnetic materials consisting of artificial atoms, that is, artificial structures whose sizes are small compared to the wavelength of respective electromagnetic (EM) wave. The effective permittivity and permeability of metamaterials can be controlled at will by changing shapes and arrangements of the artificial atoms. The concept of metamaterial is quite useful for fabricating novel optical devices such as cloaking devices. Recently, quantum metamaterial (QMM), which utilizes superconducting qubits as artificial atoms, has been theoretically proposed and its prototypes have been realized experimentally [1,2]. Unlike conventional metamaterials composed of classical elements, QMMs are expected to show several unique EM responses originating from quantum superposition and entanglement of qubits. In this talk, we will present our recent theoretical studies on the nonlinear EM response of a QMM based on superconducting qubit arrays. Especially, we will discuss on a peculiar lasing phenomena [3] and the formation of a superconducting-vortex state [4] in such systems. [1] P. Macha, G. Oelsner, J. M. Reiner, M. Marthaler, S. Andre, G. Schon, U. Hubner, H. G. Meyer, E. Il'ichev, and A.V. Ustinov, Nature Comm. 5, 5146 (2014). [2] K. Kakuyanagi, Y. Matsuzaki, C. Deprez, H. Toida, K. Semba, H. Yamaguchi, W. J. Munro, and S. Saito, arXiv:1606.04222. [3] H. Asai, S. Savel'ev, S. Kawabata, A. Zagoskin, Phys. Rev. B 91 (2015)134513. [4] H. Asai, S. Kawabata, A. Zagoskin, S. Savel'ev, arXiv:1605.04929.