

Abstract Submitted  
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**The non-linear response of a superconductor to a few-cycle THz pulse**<sup>1</sup> G.L. CARR, XIAOXIANG XI<sup>2</sup>, Photon Sciences, Brookhaven National Laboratory — We present a time-domain analysis of the response of a BCS superconductor (in the low temperature limit) to a few cycle THz pulse whose spectral content may span the absorption threshold for pair breaking. The analysis is based on the finite-difference time-domain (FDTD) approach, in combination with a model susceptibility for a superconductor that includes an explicit dependence on the energy gap[1]. The FDTD approach allows us to calculate the THz induced current density, from which we determine the modified energy gap at each instant of time during the THz wave's passage. The resulting non-linear susceptibility causes up-conversion of the incident THz wave into odd harmonics. The model results are compared with experiment for thin NbN films in both linear[2] and non-linear[3] regimes. [1] Xioaxiang Xi and G.L. Carr, *Supercon. Sci. & Technol.* **26**, 114001 (2013). [2] T. Hong et al, *J. Appl. Phys.* **114**, 243905 (2013). [3] R. Matsunaga et al, *Science* **345**, 1145 (2014).

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