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Broken time reversal symmetry states in superconductors using the ultrafast pump-probe method CHANDAN SETTY, JIANGPING HU, Purdue Univ — The excitation of vibrational modes by ultrafast optical pulses can be a useful probe of the electronic ground state in a solid through the electron-phonon interactions. In this work, we show that the phase of the oscillations of reflectivity/transmissivity as a function of the delay time can contain signatures of broken time reversal symmetry (BTRS) in the superconducting ground state. To illustrate this, we consider a simple Hamiltonian consisting of a two band electronic part and a phononic part; additionally, we include terms which couple electrons to phonons and light. In the absence of dissipation, we show that on entry into the BTRS superconducting state, the phase of the reflectivity oscillations deviates from the normal state values of $\pm\,\pi/2$ in a continuous fashion. We will also comment on the effects of dissipation and the dependence of our result on the opacity of the superconductor.

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