Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Twisting Anderson pseudospins with light: Quench dynamics in THz-pumped BCS superconductors YANG-ZHI CHOU, Department of Physics, Univ of Colorado - Boulder, YUNXIANG LIAO, MATTHEW FOSTER, Department of Physics and Astronomy, Rice University — We study the preparation and the detection of coherent far-from-equilibrium BCS superconductor dynamics in THz pump-probe experiments. In a recent experiment [Matsunaga et al, PRL. 111, 057002 (2013)], an intense monocycle THz pulse with center frequency $\omega \simeq \Delta$ was injected into a superconductor with BCS gap Δ; the post-pump evolution was detected via the optical conductivity. It was argued that nonlinear coupling of the pump to the Anderson pseudospins of the superconductor induces coherent dynamics of the Higgs mode $\Delta(t)$. We validate this picture in a 2D BCS model with a combination of exact numerics and the Lax reduction, and we compute the dynamical phase diagram. The main effect of the pump is to scramble the orientations of Anderson pseudospins along the Fermi surface by twisting them in the xy-plane. We show that more intense pulses can induce a far-from-equilibrium gapless phase (phase I), originally predicted in the context of interaction quenches. We show that the THz pump can reach phase I at much lower energy densities than an interaction quench, and we demonstrate that Lax reduction provides a quantitative tool for computing coherent BCS dynamics. We also compute the optical conductivity for the states discussed here.

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Date submitted: 02 Nov 2016 Electronic form version 1.4