ACCELERATED QUASI-PARTICLE RECOMBINATION IN CLEAN, ANISOTROPIC SUPERCONDUCTORS

Alexander Kozorezov[1], Colin Lambert[1], Csaba G. Péterfalvi[1],
Douglas Bennett[2], James Hays-Wehle[2], Robert Horansky[2] and Joel Ullom[2]

[1]Department of Physics, Lancaster University, Lancaster, UK; [2]NIST, Boulder, US
kozorezo@exchange.lancs.ac.uk

While superconducting absorbers can provide high stopping power with little heat capacity, the slow thermalization of deposited energy has limited their applicability. Pulse decays are described with at least two exponential time constants, the longer of which can be 10s of milliseconds or more. Of the many superconductors, only Sn has found common application because of its unusually fast and efficient thermalization. We have recently demonstrated that the use of glue to attach absorbers introduces an additional decay constant that gives the appearance of slow thermalization. When the glue is removed, thermalization in Sn is observed to be extremely efficient, thus raising the question why is the expected "quasiparticle bottleneck" absent in Sn?

We have developed a theory of quasiparticle recombination in clean superconductors which shows that gap anisotropy can enhance recombination by many orders of magnitude. This enhancement is due to the concentration of quasiparticles at small areas of the Fermi surface where the superconducting gap is close to a local minimum. This concentration also results in faster escape of the recombination phonons. We found that the enhancement of quasiparticle recombination in hexagonal tin may be especially strong due to the special shape of its Fermi surface.