Quenched superconductors across BCS-BEC crossover: topological states out of equilibrium

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We examine the behavior of superconductors whose interactions were suddenly quenched (changed in magnitude), a process which is easy to implement experimentally in the context of cold atoms, but which is also not entirely out of reach in the solid state context. Queches which leave the interactions weak were thoroughly studied in the past, including by some of us; we extend this analysis to quenches where initial and final interactions can be arbitrarily strong. We map out the "phase diagram" where each quench is matched with the long time behavior of the superconductor after the quench. Particularly interesting are quenches in the two-dimensional p-wave atomic condensates, as such superfluids can be topological in equilibrium. At the same time while p-wave atomic condensates are hard to bring to equilibrium in experiment because of the condensate decay their quenches are probably within the reach of experiment. We demonstrate that such superconductors reach steady states soon after their quenches which for some quenches retain the topological characteristics of their equilibrium counterparts.

[1] M. Foster, M. Dzero, V. Gurarie, E. Yuzbashyan, Phys. Rev. B **88**, 104511 (2013).
[2] M. Foster, V. Gurarie, M. Dzero, E. Yuzbashyan, Phys. Rev. Lett. **113**, 076403 (2014).