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Relaxation and persistent oscillations of the order parameter in the non-stationary BCS theory EMIL YUZBASHYAN, Center for Materials Theory, Rutgers University, Piscataway, New Jersey 08854, USA, OLEKSANDR TSYPLYATYEV, Physics Department, Lancaster University, Lancaster LA1 4YB, UK, BORIS ALTSHULER, Physics Department, Columbia University, New York, New York 10027, USA — We determine the limiting dynamics of a fermionic condensate following a sudden perturbation for various initial conditions. We demonstrate that possible initial states of the condensate fall into two classes. In the first case, the order parameter asymptotes to a *constant* value. The approach to a constant is oscillatory with an inverse square root decay. This happens, e.g., when the strength of pairing is abruptly changed while the system is in the paired ground state and more generally for any *nonequilibrium* state that is in the same class as the ground state. In the second case, the order parameter exhibits persistent oscillations with several frequencies. This is realized for nonequilibrium states that belong to the same class as excited stationary states. Our *classification* of initial states extends the concept of excitation spectrum to nonequilibrium regime and allows one to predict the evolution without solving equations of motion.

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