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Dynamical instabilities of fermion superfluids in an optical lattice[1] ARUN PARAMEKANTI, RAMACHANDRAN GANESH, University of Toronto, ANTON BURKOV, University of Waterloo — We study the breakdown of superfluidity in the attractive fermion Hubbard model in the presence of a nonzero supercurrent. Using a generalized random phase approximation as well as a strong coupling pseudospin approach, we find that there is a wide range of interaction strengths and fillings at which the superflow can break down via a novel charge modulational dynamical instability. This instability is distinct from previously studied dynamical instabilities of Bose superfluids. The charge order associated with this instability can be either: (i) a commensurate checkerboard modulation driven by softening of a roton-like mode at the Brillouin zone corner, or, (ii) an incommensurate density modulation arising from superflow-induced finite momentum pairing of fermionic Bogoliubov quasiparticles. We obtain the mean field dynamical phase diagram showing the critical flow momentum of the leading instability over a wide range of fermion densities and interaction strengths and point out experimental implications for cold atom fermion superfluids in an optical lattice.

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