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Correlated phases in the Fermi Hubbard model with spin and mass imbalance

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One dimensional attractive fermions with unequal spin populations provide a direct realization of the Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) superfluid state, in which Cooper pairs condense at finite momentum. The presence of an additional mass asymmetry between the two components gives rise to multi-particle bound states, including trimers made of one light and two heavy fermions. I first discuss the stability of these bound states through the exact solution of the three-body problem. Based on Density Matrix Renormalization Group simulations and bosonization theory, I then show that at finite and commensurate densities the ground state of the system is a Luttinger liquid of trimers. In this new phase superconducting FFLO correlations are exponentially suppressed. Finally I explain how the mass asymmetry changes the topology of the grand-canonical phase diagram of the Fermi Hubbard model. [GO, E. Burovski and T. Jolicoeur, PRL 104, 065301 (2010); E. Burovski, GO and T. Jolicoeur, PRL 103, 215301 (2009)]