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Fulde-Ferrell superfluids without spin-imbalance in three-dimensional driven spinful fermionic optical lattices CHUNLEI QU, The University of Texas at Dallas, ZHEN ZHENG, The University of Texas at Dallas; University of Science and Technology of China, XUBO ZOU, University of Science and Technology of China, CHUANWEI ZHANG, The University of Texas at Dallas — Spin-imbalanced ultra-cold Fermi gases have been widely studied recently as a platform for exploring the long-sought Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) superfluid phases, but so far conclusive evidence has not been found. Here we propose to realize an FF superfluid without spin imbalance in a three-dimensional (3D) fermionic cold atom optical lattice, where s- and p-orbital bands of the lattice are coupled by another weak moving optical lattice. Such coupling leads to a spin-independent asymmetric Fermi surface, which, together with the s-wave scattering interaction between two spins, yields an FF type of superfluid pairing. Unlike traditional schemes, our proposal does not rely on the spin imbalance (or an equivalent Zeeman field) to induce the Fermi surface mismatch and may provide a completely new route for realizing FF superfluids.

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