

Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Dark Solitons with Majorana Fermions in Spin-Orbit-Coupled Fermi Gases¹ YONG XU, LI MAO, Department of Physics, The University of Texas at Dallas, Richardson, Texas 75080, BIAO WU, International Center for Quantum Materials, Peking University, Beijing 100871, China, CHUANWEI ZHANG, Department of Physics, The University of Texas at Dallas, Richardson, Texas 75080 — Solitons, which maintain their solitary wavepacket shape while traveling, are crucially important in many physical branches. Recently, dark solitons have been experimentally observed in spin-balanced ultra-cold degenerate Fermi gases. Here we show that a single dark soliton can also exist in a spin-orbit-coupled Fermi gas with a high spin imbalance, where spin-orbit coupling favors uniform superfluids over non-uniform Fulde-Ferrell-Larkin-Ovchinnikov states, leading to dark soliton excitations in highly imbalanced gases. Above a critical spin imbalance, two topological Majorana fermions (MFs) without interactions can coexist inside a dark soliton, paving a way for manipulating MFs through controlling solitons. At the topological transition point, the atom density contrast across the soliton suddenly vanishes, suggesting a signature for identifying topological solitons.

¹Supported by ARO (W911NF-12-1-0334), AFOSR (FA9550-13-1-0045), NSF-PHY (1249293), NSFC (11344009), NBRP of China (2013CB921903,2012CB921300) and the NSFC (11274024,11334001).

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Date submitted: 01 Feb 2014

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