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Dynamical Defects in Fermi Superfluid MARK KU, LAWRENCE CHEUK, WENJIE JI, BISWAROOP MUKHERJEE, ELMER SANCHEZ, TARIK YEFSAH, MARTIN ZWIERLEIN, Department of Physics, MIT-Harvard Center for Ultracold Atoms, and Research Laboratory of Electronics, MIT, Cambridge, Massachusetts 02139, USA — We report on the study of dynamical defects in strongly-interacting Fermi superfluids. We create long-lived, solitonic excitations in a trapped Fermi gas of Lithium-6 and directly observe their oscillatory motion. As the interactions are tuned from the regime of Bose-Einstein condensation of tightly bound molecules towards the Bardeen-Cooper-Schrieffer limit of long-range Cooper pairs, the period of the defect is observed to increase markedly. We employ a tomographic imaging technique in which we directly access the local density of our 3D clouds by imaging a thin layer of atoms, achieved with a masked pumping beam that transfers atoms outside of the selected layer into an undetected state. Using the tomographic imaging, which circumvents the density integration along the probing axis, we identify unambiguously this excitation as a solitonic vortex. In particular, we rule out the vortex ring scenario predicted by several theory groups. Our measurements provide a quantitative benchmark for the theories of non-equilibrium dynamics of strongly-interacting superfluids.

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