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Solitonic Excitations in Fermionic Superfluids and Progress towards Fermi Gas in Uniform Potential MARK KU, BISWAROOP MUKHERJEE, ELMER GUARDADO-SANCHEZ, ZHENJIE YAN, PARTH PATEL, TARIK YEFSAH, JULIAN STRUCK, MARTIN ZWIERLEIN, Massachusetts Institute of Technology — We follow the evolution of a superfluid Fermi gas of ^{6}Li atoms following a one-sided π phase imprint. Via tomographic imaging, we observe the formation of a planar dark soliton, and its subsequent snaking and decay into a vortex ring. The latter eventually breaks at the boundary of the superfluid, finally leaving behind a single, remnant solitonic vortex. The nodal surface is directly imaged and reveals its decay into a vortex ring via a puncture of the initial soliton plane. At intermediate stages we find evidence for more exotic structures resembling Φ-solitons. The observed evolution of the nodal surface represents dynamics that occurs at the length scale of the interparticle spacing, thus providing new experimental input for microscopic theories of strongly correlated fermions. We also report on the trapping of fermionic atoms of ^{6}Li in a quasi-homogenous all-optical potential, and discuss progress towards directly observing the momentum distribution of the fermions in a box. This new tool offers the possibility to quantitatively study Fermi gases at finite temperature and in the presence of spin-imbalance, with unprecedented accuracy.

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