

DAMOP15-2015-000874

Abstract for an Invited Paper
for the DAMOP15 Meeting of
the American Physical Society

Ultracold fermions in periodic potentials: a bottom-up approach

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During the past years we established a technique to prepare finite samples of ultracold fermions in a tightly focused optical trap with very low entropy. We are currently expanding this technique to load periodic potentials with similarly low entropies. As a starting point we have realized a double well containing two fermionic atoms in a spin-singulett configuration. We can tune on-site interaction, tunneling rate and tilt of this basic building block of the Hubbard model. In a separate effort we have realized a strongly interacting two-dimensional Fermi gas in the superfluid regime. We are now aiming to apply our low-entropy few-particle approach to this two-dimensional system to realize finite Fermi systems in tunable periodic potentials. Progress on this effort will be reported.