Abstract for an Invited Paper
for the MAR12 Meeting of
The American Physical Society

Ultracold, trapped atomic gases as material systems[1]

WILLIAM D. PHILLIPS[2], Joint Quantum Institute, University of Maryland and National Institute of Standards and Technology, 100 Bureau Drive, Stop 8424, Gaithersburg MD 20899

Laser cooling and evaporative cooling of neutral atomic gases has led to the creation of quantum degenerate Bose and Fermi gases that constitute a new class of material systems. Many of the features of the Hamiltonians governing the behavior of these systems can be controlled and manipulated in experiments. The necessarily finite sizes of such systems are often mesoscopic in the sense that they are large enough that collective effects are important, yet small enough that the size plays a role in determining the systems' behavior. Among the experimental tools available are optical lattices, synthetic fields, and the ability to change the size and dimensionality of the system. Ultracold gases can realize some of the idealized Hamiltonians used to model condensed matter systems, creating a quantum simulation of such models, which may be calculationally intractable. Atomic gases can also provide new condensed-matter-like systems that have no analogs in real condensed matter.

[1]This work was supported by the ONR, DARPA, ARO, and the NSF through the PFC@JQI.

[2]In collaboration with Gretchen K. Campbell, Paul D. Lett, James V. Porto, and Ian B. Spielman, JQI, University of Maryland and NIST.