SES12-2012-000043

Abstract for an Invited Paper
for the SES12 Meeting of
the American Physical Society

Perfect Fluidity: From Strongly-Interacting Fermi Gases to Quark-Gluon Plasmas[1]

JOHN THOMAS, Physics Department, North Carolina State University

Strongly interacting atomic Fermi gases and quark-gluon plasmas share a common feature: They exhibit nearly ideal, minimum viscosity hydrodynamic expansion, which is a characteristic of a "perfect" fluid. A perfect fluid is defined to be a normal fluid (not a superfluid) with the minimum ratio of shear viscosity to entropy density permitted by the laws of quantum physics, $\hbar/(4\pi k_B)$, as derived recently using string-theory methods. We measure both the shear viscosity and the entropy of an optically-trapped, strongly-interacting gas of spin $1/2$-up and spin $1/2$-down ^{6}Li atoms. A bias magnetic field tunes the gas to a collisional (Feshbach) resonance, where the s-wave scattering length, for collisions between atoms of opposite spin, diverges. At resonance, the system is universal and scale-invariant, so that the thermodynamic and hydrodynamic properties are universal functions of the density and temperature. Even though it is dilute, such an atomic Fermi is the most strongly interacting non-relativistic system known, enabling tests of recent theories in diverse disciplines from high temperature superconductors to nuclear matter, and even string- theory, via the minimum viscosity conjecture.

[1]Supported by NSF, DOE, ARO, and AFOSR.