Phase diagram of superfluid ^{3}He in uniaxially compressed aerogel

R. G. Bennett[a], N. Zhelev[a], E. Smith[a], J. Pollanen[b], W. Halperin[b], and J. Parpia[a]

[a]Department of Physics, Cornell University, Ithaca NY 14853, USA
[b]Department of Physics and Astronomy, Northwestern University, Evanston, Il 60208, USA

A torsion pendulum was used to measure the dissipation (Q^{-1}) and period shift for ^{3}He confined in a 98% open aerogel that was axially compressed by 10% along the axis of the torsion pendulum. We map out the phase diagram by examining the superfluid fraction at pressures between 0 and 34 bar, taking data whilst warming and cooling. The cooling traces show evidence of the metastable A phase existing over a wider region in temperature than what is seen in other, uncompressed aerogel, as well as a much smaller reduction of T_c^a, relative to bulk T_c. On warming, we observe a narrow region of A phase before the normal liquid behavior is recovered. A study of "turn arounds", in which the cell was repeatedly warmed to temperatures approaching T_c^a and then cooled, reveals the transition from B→A to be quite broad ($\approx$ 70 μK), similar to that observed for the A→B transition while cooling. The dissipation in the A phase shows a rapid rise at a temperature just above the A→B transition. While we expect that the A phase would be stabilized by the compression (which provides an axial direction similar to the application of a magnetic field), textural alignment of the order parameter consistent with $\rho_{s\perp}$ is not seen. Our observations show that the "so-called" poly critical point is removed from the superfluid phase diagram, resulting in an equilibrium A phase sliver interceding between the normal and B phases in the zero field phase diagram of disordered ^{3}He.