A Levitated Droplet of Superfluid $^3$He-B Entirely Surrounded by $^3$He-A


Department of Physics, Lancaster University, Lancaster, LA1 4YB, UK

From our long experience of using profiled magnetic fields to stabilize and manipulate the A-B phase boundary in superfluid $^3$He, we have constructed a cell where we can create and move a droplet of B phase which is levitated within A phase. Uniquely, the A and B condensates are coherent across the A-B interface and at such low temperatures the superfluid is essentially pure, providing the most ordered phase boundary to which we have laboratory access. We configure the field so that within a bulk volume of superfluid, a region of high field (stabilizing the A phase) completely surrounds a region of lower field (stabilizing the B phase). Our preliminary measurements are at zero pressure and temperatures below $0.3T_c$ where the first-order transition from B to A phase is at $340\,\text{mT}$. We observe the formation of the droplet as we ramp the field, and we also study the transport of thermal excitations out of the droplet. Future plans include measurements at higher pressures where the A phase can be stabilized in low magnetic field at temperatures close to $T_c$. Upon cooling into the B phase we should then be able to make the first studies of nucleation uninfluenced by the presence of container walls.

Sorting category: Aa Quantum gases, fluids and solids

Keywords: superfluidity, helium-3, interface, transition, nucleation

LT1320