Confinement and Collective Behavior of ^{4}He near the Superfluid Transition

Francis M. Gasparini and Justin K. Perron

Department of Physics, University at Buffalo, the State University of New York, 14260 USA

The uniform confinement of helium near the superfluid transition reveals behavior which relates to finite-size, correlation-length scaling[1]. When two adjoining regions characterized by different length scales are involved, the overall thermodynamic behavior can be approximated as that of the individual separate regions plus a coupling. One would expect this coupling to extend over spatial distances of the order of the temperature-dependent correlation length. We have observed in recent experiments that the extent of this coupling, in magnitude, in range of temperatures, and spatial distance to be much larger than anticipated[2,3]. These observations apply to both the specific heat and the superfluid density. We will describe recent experiments which demonstrate these effects. Our work is relevant to coupling in systems near their ordering transition, and, in particular, to the case of high T_c superconductors where tunneling and proximity effects are observed across distances much larger than the correlation length[4].

[1]F. M. Gasparini, M. O. Kimball, K. P. Mooney and M. Diaz-Avila, Rev. Mod. Phys. **80**, 1009-1059, 2009.
[2]J. K. Perron, M. O. Kimball, K. P. Mooney and F. M. Gasparini, Nat. Phys, **6**, 499-502, (2010).
[3]J. K. Perron and F. M. Gasparini, J. Low Temp. Phys. **162**,136-145, (2011).
[4]I. Bozovic, G. Logvenov, M. A. J. Verhoeven, P. Caputo, E. Goldobin, and M. R. Beasley, Phys. Rev. Lett. **93**, 157002, (2004).

INVITED PAPER