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Specific Heat of Superfluid ^{3}He and Andreev Bound States

WILLIAM HALPERIN, Northwestern University

The specific heat at the normal to superfluid transition gives a clear thermodynamic signature for onset of the superfluid state marked by a discontinuity which has been accurately determined by Greywall[1]. We have measured the effect of a silver surface on the specific heat at this transition and we have found a temperature dependent suppression of the specific heat in the superfluid state which we have studied as a function of temperature and pressure[2]. This result can be understood in terms of the contribution to the Free energy from surface Andreev bound states which have a range of half of a superfluid coherence length. For the case of very large surface-to-volume ratio, as can be achieved with high porosity silica aerogel, the superfluid transition is suppressed. We have measured the specific heat anomaly at the transition temperature for this case[3] and interpret our measurements in terms of scattering theory. At the lowest temperatures a band of Andreev surface bound states dominate the specific heat of the superfluid ^{3}He/aerogel system. This work was performed in collaboration with H. Choi, J.P. Davis, and J. Pollanen at Northwestern University, supported by the NSF grant DMR-0244099. [1] D.S. Greywall, Phys. Rev. B. 33, 7520, (1986). [2] H. Choi, J.P. Davis, J. Pollanen, and W.P. Halperin, Phys. Rev. Lett. 96, 125301 (2006). [3] H. Choi, K. Yawata, T.M. Haard, J.P. Davis, G. Gervais, N. Mulders, P. Sharma, J.A. Sauls, and W.P. Halperin, Phys. Rev. Lett. 93, 145301 (2004).