Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Non-universal Casimir Effect in Saturated Superfluid ^{4}He Films at $\mathbf{T}_\lambda$[1] JOHN ABRAHAM, GARY WILLIAMS, UCLA, KONSTANTIN PENANEN, Jet Propulsion Laboratory, Caltech — Measurements of Casimir effects in ^{4}He films in the vicinity of the bulk superfluid transition temperature T_λ have been carried out, where changes in the film thickness and the superfluid density are both monitored as a function of temperature. A new Casimir film-thickening effect is observed precisely at T_λ when the temperature is swept extremely slowly. We believe this arises from the viscous suppression of any second sound modes in the superfluid film, while thermally excited second sound still propagates in the bulk superfluid to within microkelvins of T_λ, giving rise to a free energy difference between the bulk and film. At T_λ this difference drops abruptly to zero, leading to a step increase in the film thickness that we have observed. The magnitude of the step increases rapidly with the equilibrium film thickness, in agreement with a calculation of the Casimir energy balance. From the amplitude of the increase we can extract the first measurement of the second-sound free energy at T_λ, found to be about 2.6 ergs/cc. This is at least roughly consistent with a Debye-type calculation of the free energy.

[1]Work supported in part by NASA, and in part by the National Science Foundation, grant DMR-0906467

Gary Williams
UCLA

Date submitted: 15 Nov 2013 Electronic form version 1.4