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Observation of a New Casimir Effect in Saturated Superfluid ^{4}He Films[1] JOHN ABRAHAM, GARY WILLIAMS, UCLA, KONSTANTIN PENANEN, Jet Propulsion Lab — We report the results of experiments on saturated superfluid ^{4}He films in the vicinity of the bulk superfluid transition temperature T_λ, measuring the film thickness with a capacitance technique and the superfluid density with third sound. For moderately slow temperature sweep rates (0.5 mK/hr) we measure the critical Casimir film-thinning effect with good resolution, and find that the Kosterlitz-Thouless superfluid onset in the film occurs just at the start of the dip in film thickness. When warming through T_λ at extremely slow rates (a few μK/hr), however, we have observed a sudden large increase in the film thickness (nearly 25 Å in a film initially 480 Å thick) within microkelvins of T_λ. We propose that this is a new type of Casimir effect arising from the viscous suppression of second sound modes in the film, leading to a large free energy difference in the superfluid state that disappears abruptly when second sound ceases to propagate in the bulk helium at T_λ.

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