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Torsional oscillator experiments on helium films on graphite; the search for a two dimensional supersolid[1]

JAN NYEKI, Royal Holloway University of London

^{4}He films adsorbed on graphite have been investigated by torsional oscillator methods in the temperature range 2.5mK to 3.5K, focussing primarily on the behaviour of the second layer. The second layer atoms move in a ^{4}He lattice potential created by the compressed first solid layer. In our experiments, we observe an anomalous response consistent with that previously discussed by Crowell and Reppy [1]. We have made precise measurements of the film decoupling and its contribution to the dissipation over this wide temperature range. These allow us to infer $\rho_s(T = 0)$ as a function of second layer density. The results indicate a supersolid response of the second layer in the vicinity of the putative $\sqrt{7} \times \sqrt{7}$ triangular superlattice phase. The triangular lattice, unlike the square lattice, is predicted to support a supersolid phase. Cold atoms in a triangular lattice provide a candidate system to stabilise this new phase of matter, but this has yet to be realized experimentally. The "super"-response of the second ^{4}He layer as a function of filling of the underlying lattice potential will be discussed.

[1] P A Crowell and J D Reppy, Phys. Rev. B53, 2701 (1996)

[1]In collaboration with A. Phillis, J. Parpia, B. Cowan and J. Saunders.