Abstract Submitted
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Pressure driven flows of superfluid helium-4 through a single nanopipe ANGEL VELASCO, ZUZANNA SIWY, PETER TABOREK, University of California, Irvine — We have measured flow rates of helium-4 through a single etched nanopore of 31 nm diameter in mica with a mass spectrometer. Flow rates were measured as a function of pressure at constant temperature and at saturated vapor pressures along the coexistence curve between 0.5 K and 3.5 K. Due to the constraint of the mass spectrometer the low pressure side was maintained at P=0 creating an intrinsic superfluid/vapor interface which forms inside the pipe or at its exit. We observed two flow regimes at low temperatures with velocities in the range of 6 and 11 m/s consistent with Feynman's vortex critical velocity and a thermal vortex nucleation model respectively. The velocity in a laminar, viscous flow is proportional to the pressure drop while in superfluid flows to zeroth order the velocity is independent of the pressure. A first order correction shows a linear dependence on the pressure with the slope continuously varying from a positive to a negative value near the lambda point. We have also measured flow rates in the normal state and found rates in exact agreement with conventional viscous theory that incorporates the Laplace pressure and a zero slip length[1]. Supported by NSF DMR-0907495. [1] Velasco et al. Appl. Phys. Lett. **105**, 2014

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