Anomalous Sound Absorption of Finite Amplitude Sound in Liquid ^{4}He

K. Obara, Y. Kimura, A. Fukui, C. Kato, Y. Nago, H. Yano, O. Ishikawa, and T. Hata

Graduate School of Science, Osaka City University

The finite amplitude sound in both normal- and superfluid ^{4}He were studied, and we found an anomalous non-linear response. The experimental setup was as follows; the piezo-electric driver and the receiver transducers were attached at the both ends of the cylindrical cavity, and the standing wave was excited and detected by them. The frequency was kept around the resonance frequency of the liquid column, so that the maximum of the pressure field always came to the surface of the driver. As a result, in the low driving-amplitude regime, I/O ratios were linear. However, in the high driving-amplitude regime, an anomalous response were found; in the superfluid state, the signals suddenly disappeared and gradually recovered—they were repeated with random intervals. In the normal-fluid state, the signals disappeared but never recovered as long as the excitation was applied. These absorptions are expected to be the result of the sequence of the heterogeneous nucleation, the growth and the rupture of the vapor bubbles[1] at the surface of the driver transducer, not to be the homogeneous one[2] because the frequency and the pressure amplitude were not high enough. We propose that the difference between the absorption in normal- and superfluid states can be characterized by the difference of the thermal penetration length in both states. The condition of stability and the dynamics of the single vapor bubble will be discussed.

[1]Y. Hao and A. Prosperetti, Phys. Fluids **11**, 2008 (1999).
[2]S. Balibar, J. Low Temp. Phys., **129**, 363, (2002)