Prof. M. A. Herlin	R. P. Cavileer	H. H. Kolm
Dr. C. W. Garland	C. E. Chase	W. M. Whitney
B. Bernstein	E. E. Huber, Jr.	J. W. Wright
	L. D. Jennings, Jr.	

A. THE VISCOSITY OF LIQUID HELIUM

A number of modifications of the apparatus have succeeded in eliminating all mag-
netic sources of damping; a rotor operated inside an evacuated glass capsule in the
helium bath now shows effectively no deceleration. The apparatus in its present form
is shown in Fig. IV-1. In order to eliminate transverse field components caused by
obliquity of the magnet core, the magnet core is permitted to swing freely on a needle
pivot while the dewar system is aligned with respect to it. The core is then clamped in
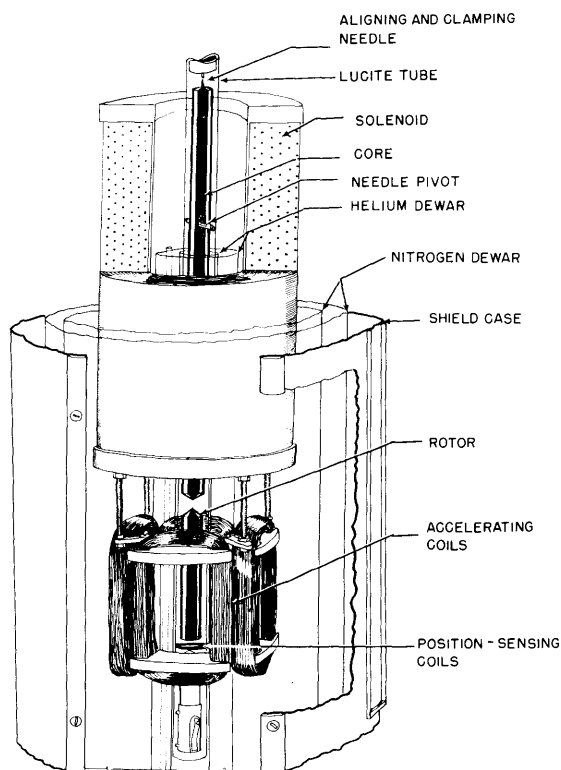position by means of the aligning needle at its upper extremity.

Fig. IV-1

Liquid helium viscometer.

The erratic damping in liquid helium has been reduced from thirty times to approxi-
mately 70 percent of the highest viscous damping to be measured (corresponding to a
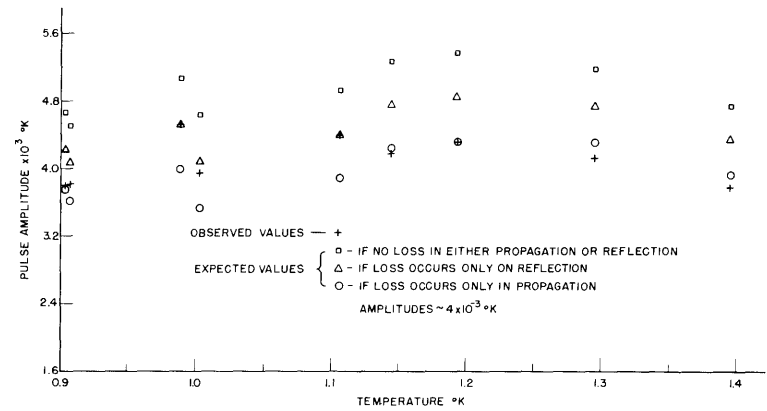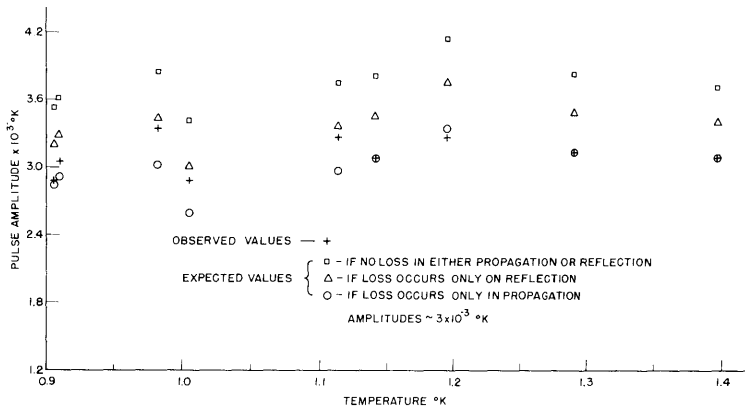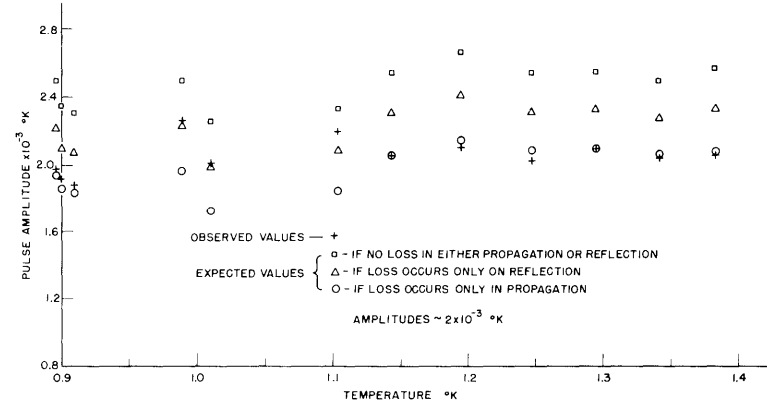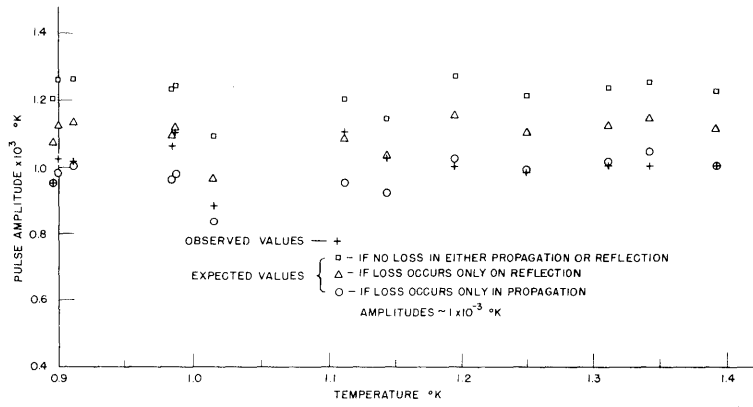viscosity of 20 micropoise at the λ point). The residual damping is believed to be caused

Fig. IV-2

Theoretical and observed pulse amplitudes vs temperature.

by mechanical noise (which incites turbulence) and by thermomechanical flow caused by eddy current heating in rotor and core. Systematic attempts to eliminate both of these effects are in progress.

H. H. Kolm

B. MEASUREMENT OF SECOND-SOUND PULSE AMPLITUDES IN LIQUID HELIUM II

Data have been taken on second-sound pulse amplitudes as a function of power input in the temperature range from 1.4°K to 0.9°K, and on pulse amplitudes observed at the receiver of 1 to 4×10^{-3} degree. The measured amplitudes are all lower than predicted values based on a theoretical formula for pulse height generation and assuming no attenuation in travel and complete reflection at the receiver.

Measurements were also made of the ratio of the heights of the initial received signal and its first echo. From these measurements one can calculate two sets of attenuation factors: one based on the assumption that loss takes place only in the reflection process; the other that the loss occurs wholly in the pulse travel. Two sets of expected values for the observed pulse amplitudes were then obtained from these measurements, the former set yielding the higher values.

The measured values and the three sets of theoretical values are plotted in Fig. IV-2.

The theoretical formula for pulse height generation was given previously (1). The specific heat values used in calculations with this formula were those of Kramers, Wasscher, and Gorter (2). The required values of second-sound velocity for use in the formula were obtained from the measurements of Maurer and Herlin (3).

The observed points from 1.4°K to 1.15°K lie very close to the theoretical points calculated from the formula referred to above and a propagation attenuation factor calculated from the measured ratios of first echo height to initial received signal. This correspondence also holds at 0.9°K. Between 1.15°K and 0.9°K there seems to be a departure. This region will be rechecked because of the possibility of experimental error.

In the lower temperature range, the phonons are known to contribute significantly to the normal fluid fraction and the entropy. The reversibility of the processes involved in the generation of second sound in the phonon-dominated temperature range is therefore checked by these measurements. Thus far, no significant deviation from reversibility can be assumed from the data.

B. Bernstein

References

1. Quarterly Progress Report, Research Laboratory of Electronics, M.I.T., July 15, 1953, pp. 22-23.
2. H. C. Kramers, J. D. Wasscher, and C. J. Gorter, Physica 18, 329 (1952).
3. R. D. Maurer and M. A. Herlin, Phys. Rev. 81, 444 (1951).