use crystals such as calcite[13] as the nonlinear medium in such measurements, where phase-matched third-harmonic generation can be achieved with two fundamental photons in the ordinary mode and one in the extraordinary mode.

In principle, second-harmonic generation can also be phase matched in a cholesteric liquid crystal. However, we have observed no phase-matching peak of second-harmonic generation at any predicted phase-matching temperature. This is presumably because the overall molecular arrangement in planes perpendicular to the helical axis has an inversion symmetry. Durand and Lee[14] and Goldberg and Schnur[15] have also found the absence of second-harmonic generation in liquid crystals and have come to the same conclusion.

We conclude that coherent optical umklapp processes arise in cholesteric liquid crystals because their helical structure provides a periodicity of the order of optical wavelengths. The same processes would also occur in crystals with periodic layers (one-dimensional superlattice) of appropriate thickness.[16]

This work was performed under the auspices of the U. S. Atomic Energy Commission.

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Propagation of Electrostatic Ion Waves Near Ion Cyclotron Harmonics

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(Received 4 December 1971)

We investigate the propagation of electrostatic ion waves above the ion cyclotron frequency; we observe resonance effects and enormous wave damping at frequencies near the ion cyclotron harmonics.

Since D'Angelo and Motley[1] reported their experimental results on electrostatic ion waves excited by a two-stream instability at the ion cyclotron frequency, many investigators have made dispersion measurements on externally excited ion waves propagating across a magnetic field. Hirose, Alexeff, and Jones observed Landau damping and the cutoff effect near the ion cyclotron frequency.[2] Ohnuma *et al.*[3] reported a dulling effect in the cutoff region due to collisions. The dispersive character of an ion wave propagating almost parallel to the magnetic field near the ion cyclotron frequency has been reported by some authors,[4] and theories of electrostatic ion waves in a magnetic field have also been investigated.[5-10]

In this Letter, we report the experimental results on a resonance effect and an enormous damping near the harmonics of the ion cyclotron frequency in perpendicular wave propagation. Experiments were performed in a *QP* machine,[11] on an argon plasma and a helium plasma produced by a P.I.G. plasma source. The plasma column was about 7 cm in diameter and 10 m in length, with a density of the order of 10^{10} cm^{-3} and an electron temperature of about 3 eV. The

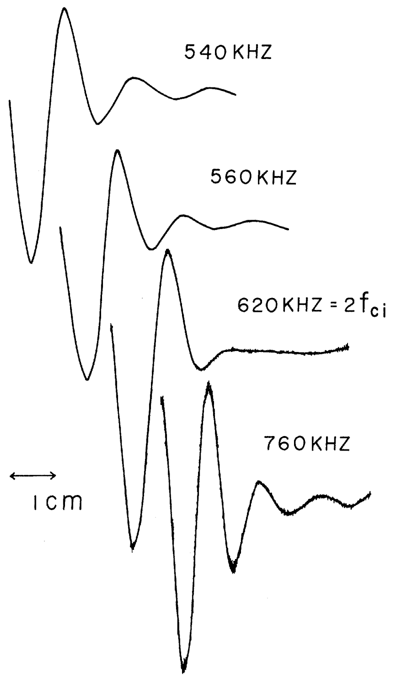

FIG. 1. Typical wave patterns detected by a lock-in amplifier when the exciting frequency is changed above and below the second harmonic of the ion cyclotron frequency. The magnetic field of 810 G is applied in a helium plasma of density $N_0 = 3.9 \times 10^{10}$ cm^{-3} and electron temperature $T_e = 3.2$ eV.

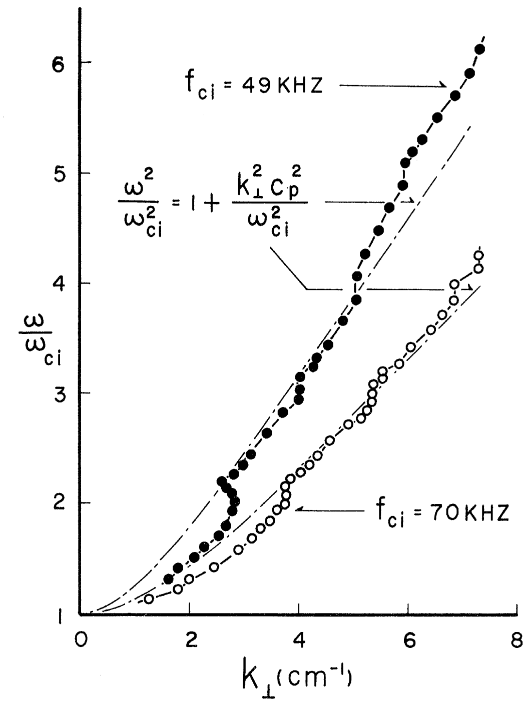

FIG. 2. Normalized frequency ω/ω_{ci} versus wave number $k_\perp$ perpendicular to the magnetic field. The magnetic field is fixed at 1280 G ($f_{ci} = 49$ kHz) and at 1840 G ($f_{ci} = 70$ kHz). Parameters of the argon plasma are $N_0 = 4.8 \times 10^9$ cm^{-3} and $T_e = 2.2$ eV.

magnetic field was varied from 750 to 3000 G. The wave was excited by a grid (2.5 cm in diameter) aligned parallel to the magnetic field, and was detected by another grid, movable across the plasma column. The wave patterns of perpendicularly propagating waves were displayed on an X-Y recorder, using an interferometer technique.

Figure 1 shows typical experimental wave patterns in a helium plasma with the magnetic field kept constant (810 G). The wave patterns show that the wave damping near the second harmonic ($2f_{ci}$) is stronger. Figure 2 shows the experimentally obtained dispersion curves in an argon plasma when the magnetic fields are 1280 and 1840 G, and when the wave frequency is changed from 60 to 320 kHz. The dot-dashed line is the dispersion relation of the electrostatic ion cyclotron wave propagating across the magnetic field, for highly nonisothermal plasma ($T_e \gg T_i$). The dispersive character of the wave in the vicinity of the ion cyclotron harmonics is evident from the figure. In Fig. 3, the e-folding damping distances δ are shown with the magnetic field strength as parameter. The damping near the second harmonic is shown to be large in comparison with that in the adjacent region. Further, the damping at $2f_{ci}$ increases with an increase of the magnetic field. Experimental results similar to those of Figs. 2 and 3 are also detected in a helium plasma in which an increased damping near the third harmonic is detected in addition to that near the second harmonic. The detection of the wave pattern propagating parallel to the magnetic field shows that the value of $k_\perp/k_\parallel$ is 1.4-1.7, which means that the excited wave in this plasma does not propagate in a direction purely perpendicular to the magnetic field.

The strong damping in this experiment is thought to be due partly to the plasma flow along the magnetic field. Collisional effects on the damping can be neglected under the experimental conditions. A larger damping near the higher harmonics of the ion cyclotron frequencies can be explained by the effect of the finite $k_\parallel$. Although the damping near the cyclotron harmonics is treated in Ref. 6, the experimental results reported are not in accord with the theoretical deductions. The dependency of the damping at $2f_{ci}$ on the magnetic field shown in Fig. 3 is opposite

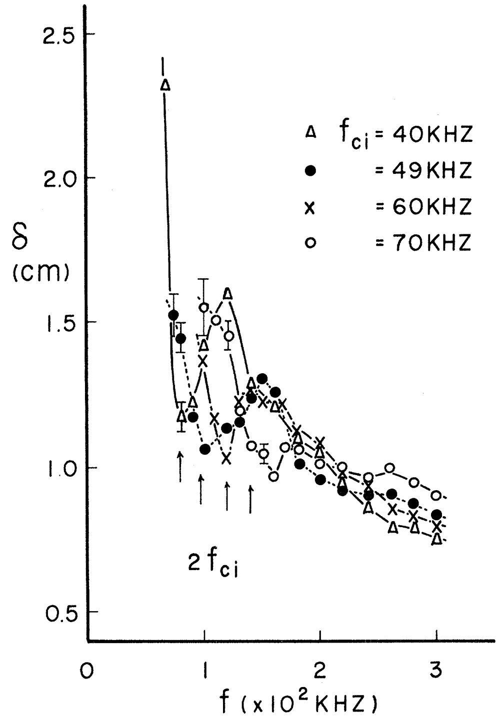

FIG. 3. Variation of e-folding damping distance δ when the exciting frequency is changed, where the parameter is the ion cyclotron frequency (f_{ci}). The experimental data are obtained in an argon plasma with the same parameters as those of Fig. 2.

to that of the ion cyclotron wave in that the damping of the latter decreases with an increase of the magnetic field.[10] Detailed investigations will be reported later. The experiments reported above were performed with an exciting voltage smaller than 10 V peak to peak, in the region where the wave damping does not change with the exciting voltage. At larger voltages the wave pattern shows amplitude oscillations[12] such as are known in the case of no magnetic field.

The authors would like to thank Professor Y. Hatta of Tohoku University and Professor K. Takayama of the Institute for their encouragement. They wish also to express their thanks to Dr. G. Horikoshi, Dr. T. Kuroda, Dr. M. Tanibayashi, and the staff of the QP machine for their help in the course of the experiment.

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Lattice Instabilities and High-Temperature Superconductivity

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Anomalously high values of the superconductive transition temperature T_c are correlated with anomalies in bond lengths in intermetallic compounds. The bond length anomalies arise from anharmonic stabilization of harmonic lattice instabilities, and confirm this interpretation of recent neutron studies of short-wavelength vibrational anomalies.

Can chemical trends in structural properties be correlated with the superconducting transition temperature T_c? The search for materials with high values of T_c has led Matthias and others to suggest[1] correlations of various kinds, particularly with the electron-atom ratio.[2,3] These suggestions, however, have found scant favor with most theorists. On thermodynamic grounds one would not expect the small energy associated with $T_c \sim 10°K$ to represent a significant contribu-