1/10 of the maximum amplitude of the exciting ion waves, with frequencies f_1 and f_2. It should be noted that the amplitude of the echo is very sensitive to the bias of the second grid. This is due to the deformation of the orbits of the ions, passing through the second grid, caused by the electric field in the ion sheath formed around the grid. No echo was observed in the plasma to the right of both grids in Fig. 1, when f_1 was greater than f_2. These results confirm that the observed wave packets are the ion-wave echoes which are predicted by Gould et al.

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TEMPERATURE DEPENDENCE OF THERMOMAGNETIC TORQUE EFFECT ON N_2 GAS*

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This Letter reports new measurements on an important, new momentum-transport effect found in polyatomic gases.[1] Figure 1 shows a torsion pendulum made of a circular cylinder which is immersed in a polyatomic gas, for example N_2 at a pressure of 0.05 Torr, with a weak magnetic field applied parallel to the cylindrical axis. A torque has been observed about that axis, but it is necessary that a temperature difference exist in the gas between the container wall and the surface of the cylinder, i.e., $dT/dr = \text{const}$. The direction of the torque will reverse if either the direction of the magnetic field or the direction of the temperature gradient is reversed. No torque exists for a gas with symmetrical atoms like argon or helium.

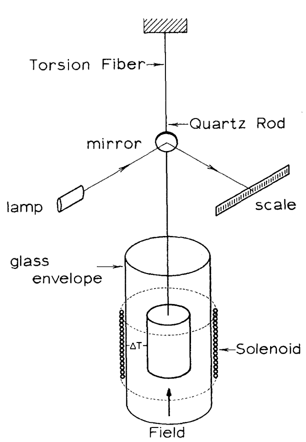

FIG. 1. Schematic diagram of equipment for measuring thermomagnetic torque effect (Scott effect).

The experimental torques are some 10^4 too large to be understood on the basis of the exchange of angular momentum, $I\omega = \hbar$, between the gas molecules and the torsion pendulum. A molecule such as N_2 at room temperature does rotate and there is a small magnetic moment which is of the order of magnitude of a nuclear magnetic moment.[2] Diatomic molecules of opposite sign of gyromagnetic ratio g_J, such as H_2, give an opposite torque effect.

Figure 2 shows data from this laboratory for the temperature dependence of the new effect. Torque per degree of temperature difference between the cylinder and the envelope is plotted as a function of the absolute temperature from 100 to 200°K at gas pressures of 0.05, 0.06, 0.09, and 0.115 Torr. The steady magnetic field applied along the axis of the cylinder was 40 Oe. It is observed that the torque is a linear function of the temperature and the slope of the line through the data points decreases as the pressure increases. At constant temperature the torque is proportional to the reciprocal of the pressure. Therefore, we con-

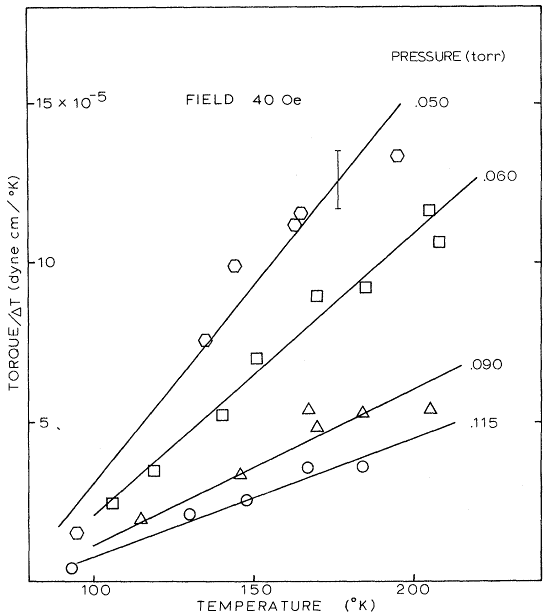

FIG. 2. Temperature dependence of Scott effect for nitrogen gas from 100 to 200°K. The typical error bar shown is large due to inaccuracies in ΔT measurements.

clude that the torque is larger for a larger mean free path. This means that a transverse force acts on the molecule for a longer time between collisions in order to give a transverse momentum. It should be pointed out that the lines through the data points appear to extrapolate to zero near the liquefaction temperature for the nitrogen. The dimensions of the apparatus were such that the mean free path of the N_2 gas was small compared to the distance from the torsion pendulum to the container wall.

The error bar shown in Fig. 2 is rather large because of inaccuracies in the measurement of the temperature gradient. Our continuing effort will be to reduce this error by reducing the vertical temperature gradient.

The observed torque, now called the Scott effect, must be caused by a transverse linear momentum transport and appears to be related to the Senftleben effect[3] which is a change of heat conductivity by the polyatomic gas in a magnetic field. Knaap and Beenakker[4] have published a phenomenological theory for the Senftleben effect which shows that there will be energy and momentum transport perpendicular to the direction of a magnetic field and perpendicular to the direction of a temperature gradient in polyatomic gases. Levi and Beenakker[5] have applied the theory to the new torque effect and have shown agreement with the room-temperature measurements of Scott, Sturner, and Williamson. They do not discuss the temperature dependence of the observed torque. It should be an interesting theoretical problem to calculate from first principles how the lack of spherical symmetry of N_2 gas can cause a weak magnetic field to give rise to a transverse force on the molecule.

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BEHAVIOR OF THE CORRELATION FUNCTION NEAR THE CRITICAL POINT

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One of the more important aspects of the problem of cooperative transitions is the relationship between the correlation function and the thermodynamic properties. It is our main purpose in this note to point out that there is a general relation limiting the possible distance dependence of the correlation function at the critical point. Let the correlation function there decrease for large distance r as r^{-n}. In terms of the exponent δ characterizing the critical isotherm ($H \sim m^{\delta}$, at $T = T_c$) we show that there is a number $\hat{n} = 2d/(\delta+1)$ for a system in d-dimensional space such that $n \geq \hat{n}$. Among other consequences, this has the result that in three dimensions the Ornstein-Zernike theory result ($n = d-2$) at the critical point cannot be correct unless $\delta \geq 5$ and thus could not apply to a system possessing the "clas-