the photomultiplier independent of the polarizing and the analysing magnetic fields. As the polarizing effect is very small, several months of continuous measurements were required to obtain the results quoted in Table 1.

The 'known spin values' are found from nuclear shell theory and from measurements by Kinsey and Bartholomew⁵. No exact measurement of P_n has been made, but it is estimated to be about 8 per cent. The errors given are mainly due to statistical variations. It is clear from these measurements that only the sign of $|P_n| \cdot P_r$ can be quoted with certainty. However, for the simple cases considered, this sign was sufficient for the determination of a few properties by use of equation (1). These are given in the last column of Table 1. The capture in nickel-58 serves as a test for the method.

Work is being carried on in order to improve the experimental arrangement.

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Hydromagnetic Waves in Ionized Gas

RECENT theoretical studies of hydromagnetic (or magneto-hydrodynamic) disturbances in ionized gas suggest that they may play a major part in the physics of some stellar atmospheres and interstellar HII regions. Such disturbances, including shock as well as weak hydromagnetic waves, provide a likely explanation of flares, coronal heating and other solar phenomena; their application to the theory of cosmic ray formation is well known.

Previous studies of hydromagnetic disturbances have, for simplicity, assumed a medium with perfect^{1,2} or isotropic³ conductivity. This assumption hides the nature of the electromagnetic field associated with the mechanical disturbance and so fails to reveal some of the most important properties of the phenomenon. Aström⁴ and Ginzburg⁵ have made further extensions but at the cost of introducing alternative restrictions.

There is a fundamental equation describing the electromagnetic field in a moving isotropically conducting medium (see, for example, ref. 6, equation 2.6 *et seq.*). It includes, among other special cases, the wireless 'telegraph' equation and leads directly and simply to hydromagnetic waves. A corresponding equation for weak disturbances in anisotropically conducting media has now been derived⁷. When only electron conductivity is important and displacement current is neglected it has the form

$$\nabla^2 \mathbf{H} = 4\pi\sigma_s \left\{ \frac{\partial \mathbf{H}}{\partial t} - \text{curl}(\mathbf{v} \times \mathbf{H}) \right\} + \frac{\sigma_2}{\sigma_1} \frac{\partial}{\partial z} \text{curl} \mathbf{H}$$

The steady magnetic field $\mathbf{H}_0$ is parallel to the z axis, and the conductivity components σ_1 and σ_2 (Hall conductivity) are perpendicular to $\mathbf{H}_0$ and to one another; $\sigma_3 \equiv \sigma_1 + \sigma_2^2/\sigma_1$ and for the gas concerned $\sigma_3 = \sigma_0$ the conductivity along $\mathbf{H}_0$. When heavy ions contribute to the conductivity (as in ionospheric region E) a term in $(1 - \sigma_3/\sigma_0)$ is added.

This equation has been used to develop a theory of weak hydromagnetic waves somewhat analogous to the well-known magneto-ionic theory of radio waves.

Three distinct hydromagnetic waves may, in general, be propagated². Two of these, which we call the ordinary (O) and extraordinary (E) hydromagnetic waves, are identical with the two corresponding radio waves found in the magneto-ionic theory. The latter are limiting cases, when heavy-ion motion becomes unimportant. The third wave resembles a sound wave and is called the S wave. The properties of the three waves depend on the relative intensities of the 'magnetic pressure' $H_0^2/8\pi$ and the gas pressure p and are briefly described for the two conditions

$$\frac{H_0^2}{8\pi} \gg p \text{ and } \frac{H_0^2}{8\pi} \ll p$$

A right-handed system of axes has Oz along the steady magnetic field and the wave normal in the xz plane at an angle θ to Oz . The angular frequencies of the wave and the heavy ions (gyrating in the magnetic field) are ω and Ω respectively.

(1) $H_0^2/8\pi \gg p$. The velocities and polarizations of the O - and E -waves are complicated functions of θ and ω/Ω . When $\omega/\Omega \ll 1$ the velocities are $V \cos \theta$ and V respectively, where $V^2 = H_0^2/4\pi\rho$ and ρ is the gas density. The waves are then nearly plane polarized along Oy and Oz (in the phase plane and perpendicular to Oy). They are only circularly polarized⁸ for vanishingly small values of θ . The electric polarization is such that $E_z \sim 0$ and $E_x/E_y \sim H_y/H_x$. The Poynting vectors are nearly along Oz and the wave normal. The gas velocity components are $v_z = 0$ and $v_y/v_x = \cos^2 \theta H_y/H_x$, movement being in elliptical orbits.

The third or S -wave has velocity $U \cos \theta$, where U is the velocity of sound. The magnetic and electric perturbations are nearly along Oz and Oy , the Poynting flux along the wave normal and the gas velocity along Oz .

(2) $H_0^2/8\pi \ll p$. When $\omega/\Omega \ll 1$ both the O - and E -waves have velocities $V \cos \theta$ and are circularly polarized. The electric field is given by $E_z \sim 0$ and $E_x/E_y = \pm i \cos \theta$ and the Poynting vectors rotate on a cone touching Oz and the wave normal. The gas velocity vectors lie in the phase planes, rotating with constant amplitude in the same direction and in contraphase with the magnetic vectors.

The S -wave has velocity $\sim U$ and magnetic and electric vectors along Oz and Oy respectively. The Poynting flux and gas velocity are along the wave normal, the wave being in effect a slightly disturbed sound wave³. In all the waves described above the absorption is determined by σ_3 ($\equiv \sigma_0$) rather than σ_1 or σ_2 .

The results given above have been extended to strong (or shock) hydromagnetic disturbances, which will be discussed elsewhere.

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