emission from a carbon target in the plasma occurs at the same time, and absorption measurements show this corresponds to $T_e \approx 2$–3 keV. A neutral particle detector shows that a large flux of fast hydrogen atoms leave the plasma perpendicular to the magnetic field, and are emitted in a time interval shorter than an ion-gyro period. The ions responsible (by charge exchange) for their ejection have a continuous spread of energies between 0·2 and 3 keV. On assumption that the ion energy distribution is isotropic and Maxwellian the measured rate of charge exchange for 2 keV ions is consistent with an ion temperature $\approx$0·7 keV.

It is argued that these observations are consistent with the development of a turbulent spectrum of longitudinal plasma waves excited by a two-stream instability, and that the electron and ion heating which occurs results from interaction of particles with the microfields of the wave spectrum, and not from binary collisions or from large-scale hydromagnetic turbulence.

Application of microwave diagnostics to a collision-free shock wave experiment*

H. HARTWIG and E. HINTZ
Institut für Plasmaphysik der Kernforschungsanlage Jülich des Landes Nordrhein-Westfalen e.V., Federal Republic of Germany, Association Euratom–KFA

SHOCK front structures are generally investigated by measuring magnetic field profiles. Depending on the shock wave type it may also be desirable to observe the density profile. This becomes a necessity if the initial magnetic field is very small, i.e. if $\beta_0 = 8\pi n_0 k T_0/B_0^2 \gg 1$. For this reason a 2 mm microwave probe with high space resolution ($\approx$3 mm) has been developed which can be used between $n_e = 10^{13}$ and $n_e = 2 \times 10^{14}$ cm^{-3} [1].

Shock waves were produced in θ-pinch geometry. Radial and axial density profiles in the initial plasma have been determined as a function of time with probes of this type. In order to resolve the density jump in a collisionless shock wave, a response time of about 10 nsec is needed. Due to the high impedance of 2 mm detectors and the stray capacitance of the detector mount, the time constant of the system is presently limited to 20 nsec.

Interferometer measurements with this time resolution will be presented. From the observed phase shift, the density jump in the shock front is determined. In addition one can relate the attenuation of the signal to the effective conductivity of the plasma [2]. These measurements are compared with other observations, in particular with measured magnetic field profiles.

* Presented by H. HARTWIG.

[1] H. HARTWIG, Berichte der Kernforschungsanlage Jülich, Jül-473-PP (April 1967).
[2] R. KH. KURTMULLAEV, V. L. Pilskii, Institut für Kernphysik der Sibirischen Abt. der Akademie der Wissenschaften der UdSSR, Preprint No. 42, Novosibirsk (1966).

On the use of Langmuir probes in a Q-Device*

M. HASHMI, A. J. VAN DER HOUVEN VAN OORDT, F. RAU and J. G. WEGROWE
Institut für Plasmaphysik GmbH, Garching bei Munich, Germany

THE complexity of the theories of Langmuir probes in a magnetic field and their wide application in magneto-plasmas as a diagnostic tool suggests a comparison of the probes with other diagnostic techniques. Recently, such a comparison has been performed in a singly ionized barium plasma for the single-ended operation of a Q-device using resonance fluorescence scattering of the 4554 Å line by barium ions and microwave cavity as independent methods [1].

In the present work a comparison of the probe density is performed with the above-mentioned methods in double-ended and single-ended operation under various operating conditions, namely, by changing the density, magnetic field, plate temperature, degree of ionization and ion temperature. The last two being changed by introducing a noble gas [2]. The density was evaluated from the extrapolated value of the ion saturation current at the plasma potential. It is found that

$$\frac{n_m}{n_s} = 0{\cdot}6, \quad \frac{n_p}{n_s} = 2, \quad \text{and} \quad \frac{n_{p'}}{n_s} = 1{\cdot}4,$$

* Presented by M. HASHMI. Paper to be submitted to *The Physics of Fluids*. This work was performed under the terms of the agreement between the Institut für Plasmaphysik Gmbh, Munich-Garching, and EURATOM to conduct joint research in the field of plasma physics.