## New Determination of the Magnetic Moment of the Proton in Terms of the Nuclear Magneton

THE ratio of $f_s$, the spin precession frequency of the proton, to $f_c$, the cyclotron frequency, in the same magnetic field is equal to the ratio of the magnetic moment of the proton $\mu_p$ to the nuclear magneton[1] $\mu_n$.

$$f_s/f_c = \mu_p/\mu_n$$

The ratio is used at present in combination with other experimentally measured constants to derive the best values for the atomic constants[2]. The uncertainties of current estimates of the Faraday constant, ratio of proton to electron mass, electronic charge, nuclidic mass unit and many other important constants are effectively determined by the uncertainty of $\mu_p/\mu_n$.

Our measurements were made at 0·47 tesla (4·7 k gauss). The spin precession frequency was measured with an amplitude bridge[3] and the cyclotron frequency using the omegatron method[4]. The omegatron was of the quadrupole type[5] and had split plates to improve the uniformity of the radio frequency field. Ratios of the masses of ions are known with great precision and may be regarded as auxiliary constants[2]. The cyclotron frequencies of hydrogen ions ($H_2^+$), deuterated hydrogen ion ($HD^+$) and deuterium ions ($D_2^+$) were measured, and this enabled the shifts in the cyclotron frequencies caused by electrostatic fields to be eliminated.

The results of forty-three sets of three ion resonances, with standard deviations (including both systematic and random errors), are

$$\mu_p/\mu_n = 2{\cdot}792\,74 \pm 0{\cdot}000\,05 \text{ without and}$$
$$\mu_p/\mu_n = 2{\cdot}792\,82 \pm 0{\cdot}000\,05 \text{ (19 p.p.m.) with}$$

the correction for the diamagnetism of the water sample[6,7], respectively. This lies within 1·1 standard deviations of the present best value and midway between the values which were included[4,8,9] in the 1965 evaluation and those which were rejected[10] or too late[11] to include. It is hoped to increase the precision of the method by a factor of ten by working at higher magnetic fields.

This work forms part of the research programme of the National Physical Laboratory.

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## Air Flow with Arc Present

THE behaviour of a flowing gas when disturbed by the presence of a high current arc has always been of great interest to circuit-breaker engineers and physicists.

The intense light of the arc under investigation is generally so much greater than that of the conventional background light source of the interferometer or Schlieren system used that it is extremely difficult, and in most cases quite impossible, to photograph the gas movement. This difficulty has been overcome by using a laser in place of the conventional light source of the interferometer system.

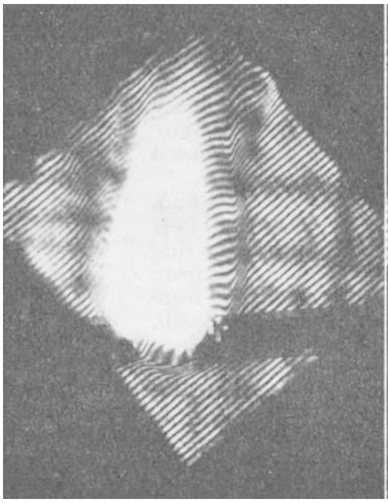

Fig. 1.

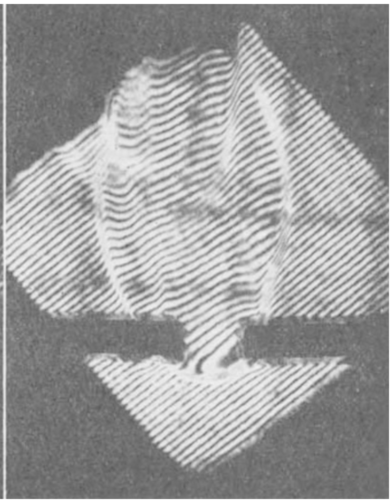

Fig 2.

Fig. 1 is an interferogram of an arc between two horizontal electrodes; the intensity of the laser light source of the optical system is in this case comparable with that of the outer boundary of the arc.

The property of the laser to emit most of its light in a single intense spectral line allows a marked improvement to be made. Fig. 2 was taken with a laser light source, using a very narrow band interference filter between the arc and the camera which allows the light from the laser to reach the film, but cuts off practically all the light from the arc itself, except the relatively small continuum emitted at the laser wavelength. This interferogram shows no obliteration at all, and the fringes can be followed not only in the vicinity of the arc, but also right into the centre of the arc itself.

The records were obtained using a Schlieren polarization interferometer with one Wollaston prism and an analyser. The principle of operation of such an arrangement with a conventional light source has been given by Merzkirch[1]. It applies equally well to the laser light source, which has the additional advantage of simplified "setting up" procedure and very considerable improved quality of the fringes.

This work was a preliminary investigation to prove the principle of the idea, and the technique will now be applied to the study of gas-flow behaviour in the presence of high-power arcs.

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