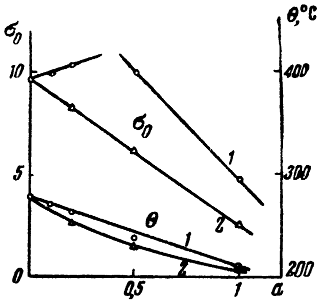

FIG. 1. Dependence of the magnetization σ_0 at 4.3°K (in Bohr magnetons) and the Curie point Θ on content a of Cr^{3+} and Al^{3+} ions in yttrium ferrite-garnet: 1) Cr^{3+}; 2) Al^{3+}.

at contents $a > 0.5$ the value of σ_0 decreases. The Curie point decreases in all cases, both on replacement by Al^{3+} and on replacement by Cr^{3+} (Fig. 1). These results are in agreement with the data of Pauthenet.[3]

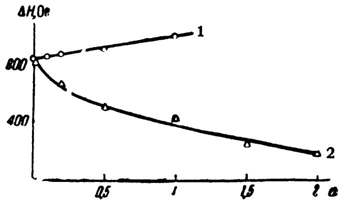

FIG. 2. Dependence of the width of the absorption line on content of Cr^{3+} and Al^{3+} ions in yttrium ferrite-garnet: 1) Cr^{3+}; 2) Al^{3+}.

Figure 2 gives the results of the measurements of ΔH, the width of the absorption line. The value of ΔH increases with increase of Cr^{3+} content, whereas it decreases with increase of Al^{3+} content. Since the magnetic anisotropy is very small in yttrium ferrite-garnet, it is possible to calculate the value of the g-factor with satisfactory accuracy. With increase of Cr^{3+} content, the g-factor rises from a value 2.150 ± 0.005 (for $3Y_2O_3 \cdot 5Fe_2O_3$) to 2.200 ± 0.005 (for $3Y_2O_3 \cdot 4Fe_2O_3 \cdot Cr_2O_3$), while upon increase of Al^{3+} content the g-factor drops to a value 2.030 ± 0.005 (for $3Y_2O_3 \cdot 4Fe_2O_3 \cdot Al_2O_3$). Comparison of the curves for ΔH, σ_0, and Θ (Figs. 1 and 2) shows that the value of ΔH is directly related to the values of σ_0 and Θ (in the case of replacement by Al^{3+}): the smaller σ_0 and Θ, the smaller ΔH. This is qualitatively in agreement with the deductions of the theory,[4] according to which ΔH in ferrites should be proportional to the values of σ_0 and of Θ. In the case of replacement by Cr^{3+} ions, as Figs. 1 and 2 show, the experimental data on the change of the values of ΔH, σ_0, and Θ are in contradiction to the theory mentioned.

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ELECTRIC FIELD IN A MICROWAVE PLASMA AS A FUNCTION OF TIME

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IT is of considerable interest to study the formation of a pulsed ultrahigh frequency (UHF) discharge from the onset of breakdown to the time at which the electron density, electric field, and other plasma parameters assume their steady-state values.

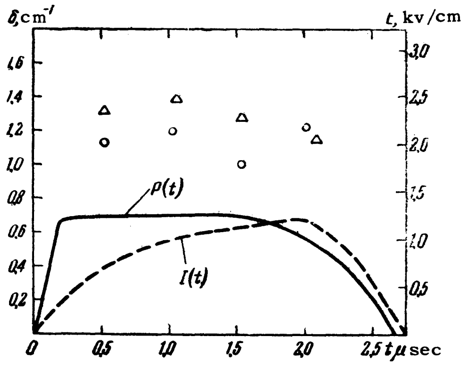
We have investigated the time dependence of the electric field during the transient period in a pulsed UHF discharge at 9400 Mcs. The field strength was measured optically by noting the Stark effect of the Balmer lines in the external oscillating field.[1,2] The microwave plasma was generated in a narrow capillary approximately 2 mm in diameter which was placed in a waveguide with cross section 23×10 mm^2.

An analysis was made of the transverse radiation with respect to the direction of the electric field. The spectral analysis apparatus was a DFS-2 diffraction grating (theoretical resolving power of 80,000). The analysis of the spectrum and the determination of the parameters of the H_β line used for the experiment were made by means of a photo-electric scanning attachment on a FEU-19 photomultiplier. To make it possible to examine the line shapes corresponding to various stages of the UHF pulses ($\tau = 2\,\mu$sec) a time-selection system was used to examine the signal from the FEU.

The triggering pulses were approximately 0.1 μsec long and could be shifted in steps of 0.1 μsec. It is assumed that the quantity being measured was essentially constant over a 0.1 μsec period. Since the repetition frequency was about 400 cps and the scanning was carried out rather slowly the results of the measurements represent averages over several thousand illumination pulses.

The measurements were carried out in deuterium at a pressure of several millimeters of mercury. In the figure is shown the time dependence of the electric field inside the plasma during a uhf pulse. In the same figure is shown the UHF pulse in the waveguide in which the capillary was located and an oscillogram of the intensity of the H_β line in relative units (same time scale for all quantities).

During the entire UHF pulse the amplitude of



P (t) – oscillogram of the power; I (t) – oscillogram of the intensity; δ – half-width of the Stark line; E – amplitude of the electric field; o – 4 mm. Hg; Δ – 23 mm. Hg.

the electric field inside the plasma remains essentially constant. On the other hand the luminous intensity, which may be interpreted as reflecting the time behavior of the electron density, shows the monotonic increase of the latter.

These results indicate that in this experiment we are dealing with the stage of discharge formation which precedes the establishment of the stationary state conditions; in the steady state the electric field is considerably smaller.[3]

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A GENERAL FORMULA FOR THE ELECTROMAGNETIC SCATTERING OF TWO DIFFERENT PARTICLES OF SPIN 1/2

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In view of the possibilities for experiments on the scattering of μ mesons by nucleons it is desirable to generalize the formula for the scattering of high-energy electrons by nucleons (the Rosenbluth formula) in two ways: first, to take account of the mass of the incident particle, and second, to postulate for this particle also an internal structure described by form factors $F_\mu(q^2)$ and $\Phi_\mu(q^2)$.

The charge-current density both for the nucleon and for the incident particle is taken in the form

$$\bar{u}_2 Q u_1, \quad \text{where } Q_i = \gamma_i F(q^2) + i\Phi(q^2)[\gamma_i, \hat{q}],$$

q is the four-vector momentum transfer; u_2 and u_1 are spinors. The square of the matrix element, averaged over the initial spin states and summed over the final spin states, is given by

$$|\mathfrak{M}|^2 = \frac{1}{E_1E_2E_1'E_2'q^4}\Big\{\frac{1}{4}F_\mu^2F_N^2[-q^2(M^2+\mu^2)+2(p_1\cdot p_1')^2 + 2(p_1\cdot p_2')^2] + F_\mu^2\Phi_NF_NMq^2[q^2-2\mu^2] + F_\mu^2\Phi_N^2[M^2q^4 + 4q^2(p_1\cdot p_2')(p_1\cdot p_1') - 4q^2M^2\mu^2] + F_N^2\Phi_\mu F_\mu\mu q^2 \times [q^2-2M^2] + 12\Phi_N\Phi_\mu F_NF_\mu M\mu q^4 + 4\Phi_N^2\Phi_\mu F_\mu\mu q^4 \times [4M^2-\tfrac{1}{2}q^2] + F_N^2\Phi_\mu^2q^2[q^2\mu^2+4(p_1\cdot p_1')(p_1\cdot p_2') - 4M^2\mu^2] + 4\Phi_NF_N\Phi_\mu^2Mq^4[4\mu^2-\tfrac{1}{2}q^2] + 4\Phi_\mu^2\Phi_N^2q^4 \times [4M^2\mu^2-(M^2+\mu^2)q^2+2(p_1\cdot p_1')^2 + 2(p_1\cdot p_2')^2 - \tfrac{1}{4}q^4]\Big\}.$$

The primed quantities refer to the incident particle, the unprimed to the nucleon.

The differential cross-section is

$$\frac{d\sigma}{d\Omega} = \frac{e^4}{(2\pi)^2 v_{\mathrm{rel}}}|\mathfrak{M}|^2\rho, \quad \text{where } \frac{e^2}{4\pi} = \frac{1}{137}, \quad v_{\mathrm{rel}} = \frac{p_0}{E_0}.$$

In the laboratory system we have

$$E_1 = M, \quad E_2 = W, \quad E_1' = E_0, \quad E_2' = E;$$
$$(p_1\cdot p_1') = -ME_0, \quad (p_1\cdot p_2') = -ME, \quad q^2 = 2M(W-M);$$
$$\rho = p_\mu^2WE/(p_\mu E_n - Ep_0\cos\vartheta).$$

The magnitude of the momentum and the energy of the scattered meson are given by[1]

$$p_\mu = p_0\frac{(E_0M+\mu^2)\cos\vartheta + E_n\sqrt{M^2-\mu^2\sin^2\vartheta}}{E_n^2-p_0^2\cos^2\vartheta};$$
$$E = \frac{E_n(E_0M+\mu^2)+p_0^2\cos\vartheta\sqrt{M^2-\mu^2\sin^2\vartheta}}{E_n^2-p_0^2\cos^2\vartheta};$$
$$E_n = E_0 + M = E + W; \quad p_0^2 = E_0^2 - \mu^2.$$

In the case in which the mass of the incident particle can be set equal to zero the expressions become much simpler:[2]

$$\frac{d\sigma}{d\Omega} = \left(\frac{e^2}{8\pi E_n}\right)^2\frac{1}{\sin^4(\vartheta/2)}\left[1+\frac{2E_0}{M}\sin^2\frac{\vartheta}{2}\right]^{-1}\Big\{F_\mu^2\cos^2\frac{\vartheta}{2} \times\Big[F_N^2\Big(1+\frac{q^2}{2M^2}\tan^2\frac{\vartheta}{2}\Big) + \Phi_NF_N4\frac{q^2}{M}\tan^2\frac{\vartheta}{2} + \Phi_N^2 4q^2 \times\Big(1+2\tan^2\frac{\vartheta}{2}\Big)\Big] + \Phi_\mu^2\Big[4F_N^2q^2 - \Phi_NF_N\frac{8q^4}{M}\sin^2\frac{\vartheta}{2} + 16\Phi_N^2q^4\Big(\cos^2\frac{\vartheta}{2}+\frac{q^2}{4M^2}\sin^2\frac{\vartheta}{2}\Big)\Big]\Big\}.$$